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AND ENGINEERING JOURNAL

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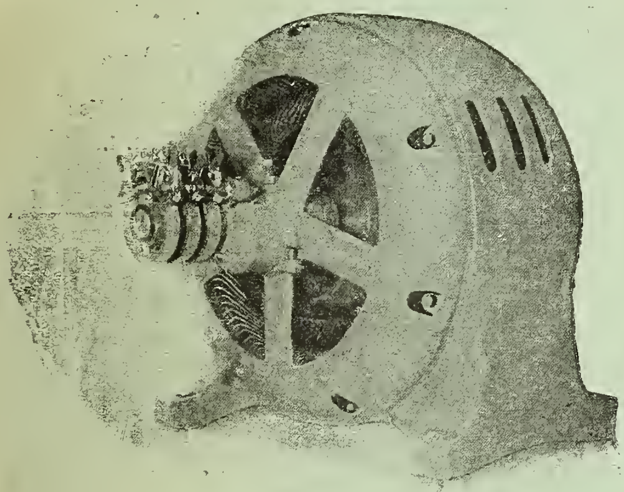

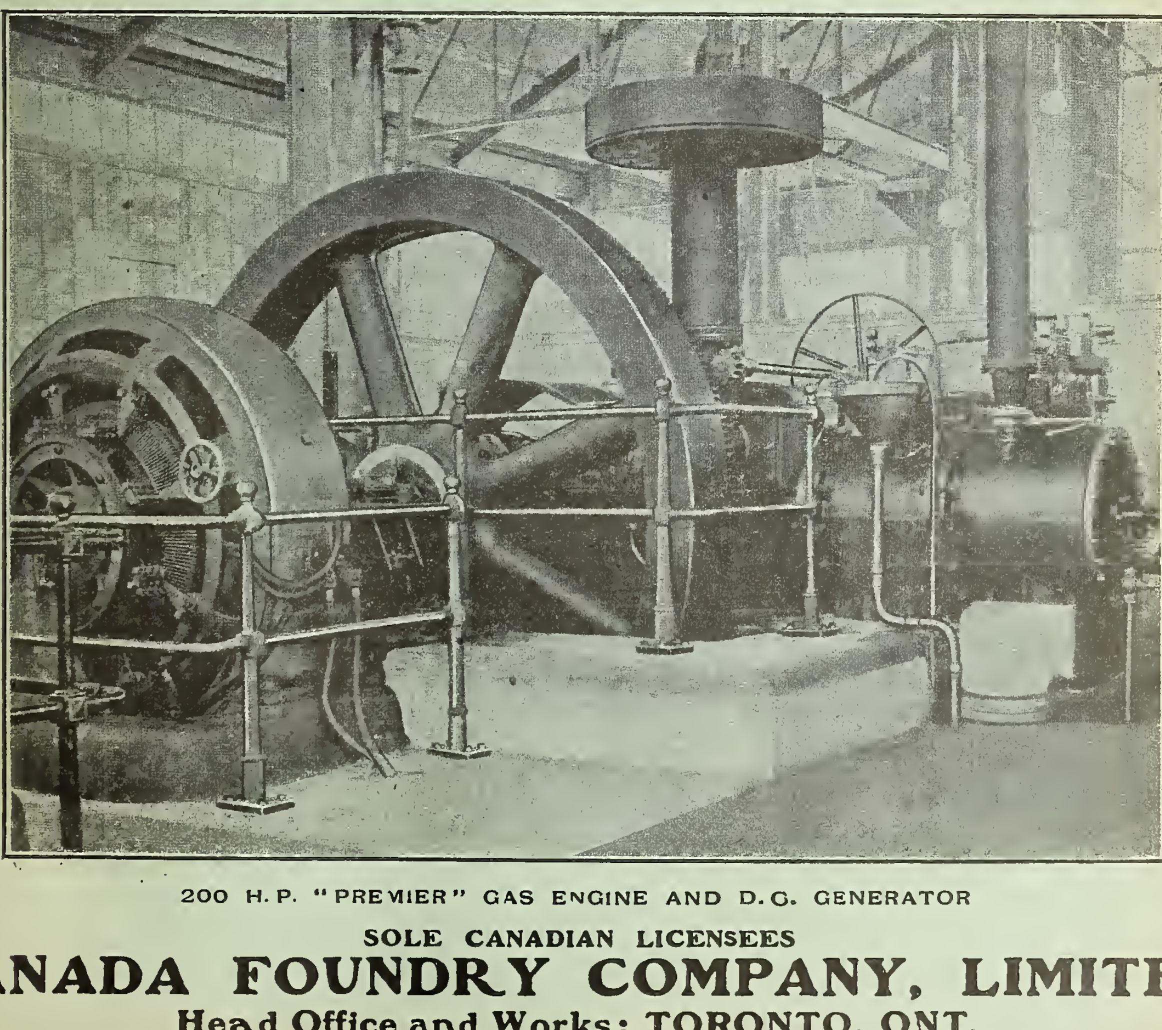

SPARKS.

The Saraguay Light & Power Company, of St. Cesaire, Que., have made application for permission to distribute electric light and power in the city of Montreal.

The installation of a series of electrical clocks for the C. P. R. Windsor street offices in Montreal is now under way. There will be several hundred time-pieces, which will be electrically controlled from a central machine.

The Shawinigan Lakes Power & Electric Company, Shawinigan Falls, Que., have made application to change the name to the Shawinigan Hydro-Electric Company.

The Grand Falls Power Company have made application to the City of St. John, N.B., for a franchise. The company are now prepared to proceed with the development of power as soon as their plans have been approved by the Dominion Government. These plans were prepared by A. C. Rice, of Winchester, Mass., for the hydraulic work, and by Mr. R. D. Mershon, of New York, for the electrical equipment. Mr. Rice estimates the power which may be developed at Grand Falls under present conditions at 60,000 h. p., which could be increased by means of a storage system to 80,000 h.p. The company are willing to guarantee to furnish power to St. John for a period of thirty years at prices in no case exceeding the following maximum rates : For 500 h.p. or over for a 24 hours service, $45 per h.p. per year. For 500 h.p. or over for 10 hour service, $40 per h.p. per annum, and for 500 h.p. or over for 10 hours, exclusive hours 4 to 8 p.m. On the same basis for 100 to 500 h.p. the prices are $50, $45, $40 per h.p. per annum, and for 5 to 100 h.p. on the same basis, $55, $50 and $45. Figures are also given for the supply of power to those requiring power only intermittently or in small quantities. The company promise this on condition that they are given an exclusive franchise for the transmission of power to and within the city for the period of fifteen years, subject only to the rights now vested in the Street Railway Co.

SPARKS.

Mr. C. J. Brown, City Clerk of Winnipeg, is asking for tenders up to January 14 for the supply of a 750 k.w. generator and two 250-h.p. boilers.

The Delhi Light & Power Company have let the contract for their generators to the Warren Electric Company, Sandusky, Ohio.

The Merchants Light & Power Company are seeking incorporation from the Quebec Government for the purpose of supplying light and power. P. R. DuTremblay, Montreal, Que., is solicitor for the applicants.

The power plant of the Capital Power Company at Deschenes, Que., was last month sold by public auction to the C.P.R. for $240,000. This purchase indicates that the C.P.R. propose at an early date to experiment in the electrification of some of their branch lines. It is probable that the Pontiac & Pacific Junction Railway, which runs through Aylmer and Deschenes into Ottawa, will be the first to be converted to an electric system.

SPARKS.

A delegation from the Electrical Contractors' Association recently appeared before the Fire Committee of Montreal in the interests of getting all electric wiring inspected by the city before it could be used. It was pointed out that the system had been established in many large American cities and was giving satisfaction. The question of the city's responsibility in the event of a fire taking place after the wiring had been passed was brought up by a member of the Fire Committee. A sub-committee will report on the matter.

Mr. W. M. Alexander, of Brandon, Man., is considering a proposition to develop a large water power at Calgary.

The Crows Nest Pass Coal Company have acquired a water power at Elko, B.C., and are having reports made by engineers with a view to the development of electric power.

The corporation of Port Perry, Ont., have asked permission from the Ontario Government to develop the water power at Buckhorn Rapids, on the Trent river, about 41 miles north of the town. It is estimated that about 870 h.p. can be developed.

SPARKS.

Allis-Chalmers-Bullock, Limited, Montreal, Que., were recently awarded the contract for the supply of a 75-kilowatt generator for the Town of Goderich. The amount of their tender was $3,574.

A notice in the Manitoba Gazette states that Allis-Chalmers-Bullock, Limited, have been granted a license to do business in the province of Manitoba. Mr. R. H. Zavitz, of Winnipeg, will be principal agent for the province.

The Engineers' Club of Montreal have decided to apply to the Quebec Government at their next session for an act to amend its constitution and to increase its powers.

A charter under date of November 28th, 1906, was granted by the Ontario Government to the Liskeard Light, Heat & Power Company, Limited, of New Liskeard, Ont. The provisional directors of the company are K. Farrah, J. Armstrong, J. J. Grills, H. Hartman, and F. L. Smiley, and the authorized capital of the company is $200,000.

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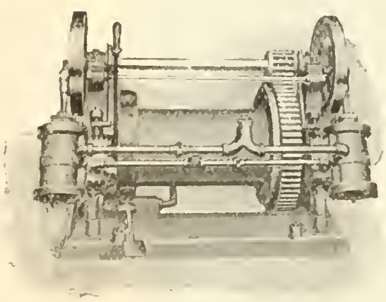

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CANADIAN
ELECTRICAL NEWS
AND
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VOL. XVII. JANUARY, 1907 No. 1

The Steam Plant of the Western Counties Electric Company

The Western Counties Electric Company, which some months ago secured control of the Brantford Electric and Operating Company, have recently completed an auxiliary steam plant situated at the Locks and built with a view to insuring a continuous supply of current to the Company's light and power system at Brantford, some three miles distant.

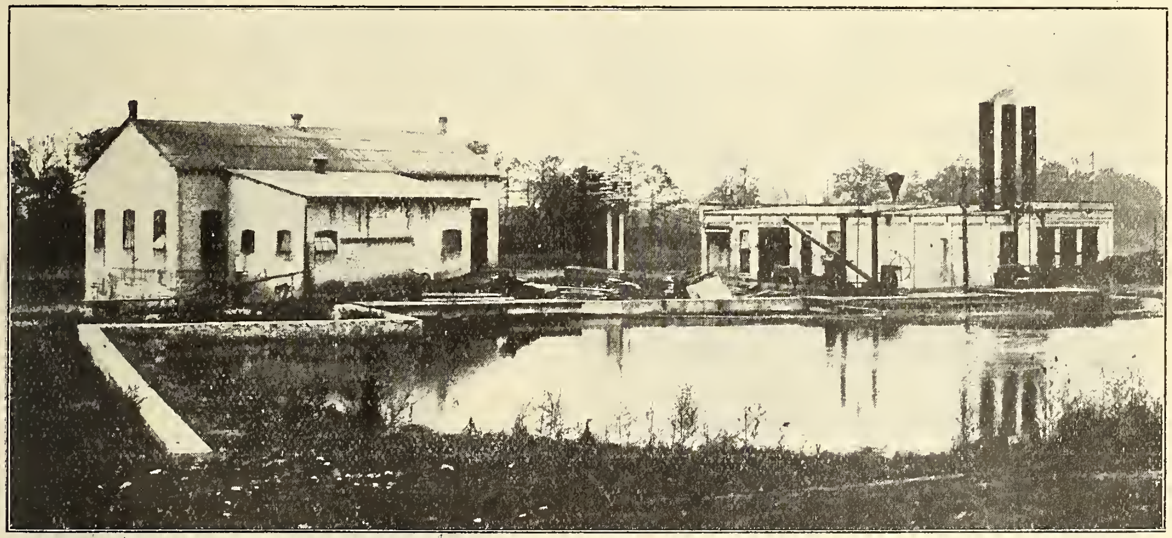
The conditions at the water power plant are somewhat unusual. While the normal head is 33 feet, during the spring freshets the water rises 24 feet above the summer normal, thus increasing the available head to about nine feet. It will thus be seen that a steam plant differing in some respects from one that would be operating continuously is essential to maintain the supply of energy during the periods of the abnormal river flow.

The steam plant building is of exceptionally substantial construction, the footings being of concrete some three feet in thickness; the structural work is entirely of steel, the floor of concrete and the roof concrete reinforced with interlocking steel fabric, the concrete being haunched on the I beam flanges and walls. The cement is covered with 5-ply tar felt and then treated with Trinidad plastic asphalt. Although this roof was constructed in midwinter it is absolutely waterp-roof and shows no signs of cracking.

The steam plant proper was furnished by the Waterous Engine Works Company, Brantford, and consists of the following:

Three return tubular boilers, each 78 in. dia. x 18 ft. long, each with 92 tubes 4 in. diameter by 18 ft. long.

One tandem compound McEwen engine with cylinders 19 in. and 32 in. diameter by 24 in. stroke, developing 600 indicated horse power when cutting off at 3/8 stroke, with an initial steam pressure of 125 lbs. in steam chest and running condensing. Maximum capacity at 125 lbs. steam pressure and condensing, 800 indicated horse power. The guaranteed steam consumption at its most economical load, running condensing, is 18 lbs. per indicated horse power at an initial steam pressure of 125 lbs. with dry steam containing not more than one per cent. moisture.



THE TWO POWER STATIONS OF THE WESTERN COUNTIES ELECTRIC COMPANY, BRANTFORD, ONT.

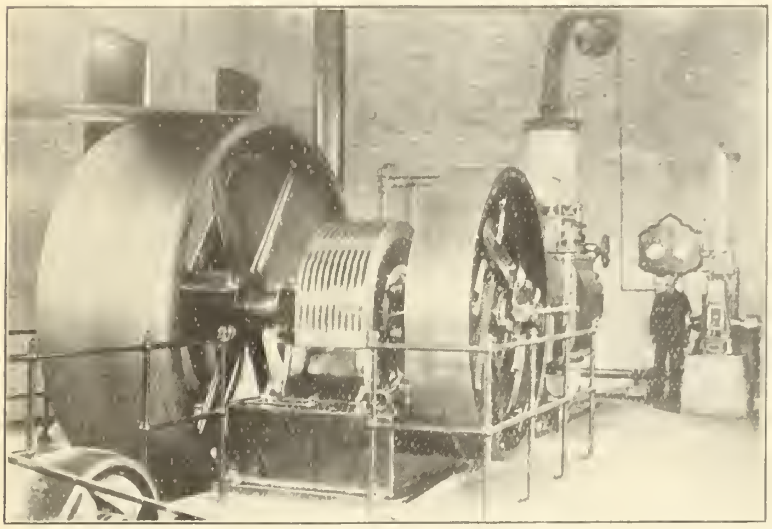
Two Erie City feed water heaters of a combined capacity of 750 H. P.

One single cylinder direct acting air pump and jet condenser built by the Snow Steam Pump Works, Buffalo, N. Y., having 6 in. suction injector pipe flange, 14-inch engine exhaust flange. This condenser has a capacity capable of handling 15,000 lbs. of steam per hour with injection water at 60 degrees Fahr. The air pipe can draw water through 150 feet of pipe.

Each boiler is provided with an individual smoke stack 40 inches in diameter and 30 feet high. To provide for rapidly getting up steam, a Sturtevant

steel fan blower with blast wheel 4-1/2 ft. diameter x 26-1/2 in. wide is installed. This blower, which has a capacity of 16,400 feet per minute at 410 R.P.M., is direct connected to a Sturtevant engine, provision being made for electric drive by interposing the pulley between the fan and the engine. This engine is of Sturtevant V. S. V. 5 type with cylinder 5 in. diameter x 5 in. stoke.

The generator, which is belted to the engine by means of a 3-ply Saddler & Haworth leather belt 44 inches wide, was furnished by the Canadian General Electric Company, and is of the A. T. B. revolving field type, 3 phase, 2400 volts, 60 cycles, and operating at 360 R. P. M. The capacity of the generator is 400 K. W.



ENGINE ROOM END OF STEAM STATION, WESTERN COUNTIES ELECTRIC COMPANY.

The plant was built from plans and specifications furnished by Mr. R. S. Kelsch, consulting electrical engineer of Montreal, under the supervision of Mr. Louis W. Pratt, and was designed with a view to duplicating it if found necessary.

FIRE RISK FROM SIGNAL WIRES.

Exception has been taken by the Electrical Inspector of the Canadian Fire Underwriters Association of Toronto to the condition of the maize of the various call bell and other signal wires which are stretched throughout and over the City of Toronto. This is unquestionably a very important point, and where high potential currents are so prevalent and also where trolley wires are so much in evidence, these bare signal wires, which are as a rule put up with little or no regard to mechanical construction or safety, become a danger which it is well to take into consideration. The National Electrical Code, page 122, rule 64, states clearly what is required in reference to these wires, and in all large American cities to-day the ordinance and the Underwriters' rules both are most emphatic and stringent in the regulation thereof.

It is understood that the engineers for Winnipeg's power plant at Point du Bois have decided that the first development will be of 20,000 horse power. The turbines proposed will be 6,000 h. p. each, of the Parsons type, directly connected to 3,000 kilowatt generators delivering three phase current at 2200 volts and 60 cycles frequency. The generators will be of the revolving field type, with 44 poles. The transformers will receive the current at 2200 volts and raise it to 66,000 volts for transmission. The connections will be delta to delta.

ANNUAL MEETING OF ENGINEERS' CLUB OF TORONTO.

The eighth annual meeting of the Engineers' Club of Toronto took place on Thursday, January 10th, when about 60 members were present. The chair was taken by the President, Mr. F. L. Somerville.

After the reports of the Executive and other committees were received and adopted, several important recommendations were made, one of which was that larger club rooms be secured. The incoming Executive were instructed to report on the advisability of issuing a directory containing the names of the members, the particular branch of engineering which they practise and other information concerning the Club.

Before accepting nominations for officers President Somerville advised the members to be careful in their selections, as the progress of the Club during the coming year would depend largely on the officers.

From the selection made the success of the Club during 1907 would seem to be assured. Those elected were: President, C. B. Smith; First Vice-President, J. G. Sing; Second Vice-President, A. B. Barry; Secretary, Willis Chipman; Treasurer, John S. Fielding; Chairman of Rooms Committee, C. M. Caniff; Chairman of Library Committee, A. F. Macallum; Chairman of Papers Committee, R. G. Black; Auditors, W. E. Douglas and W. H. Patton.

The President then made a short address, congratulating the Club on its success during the past year and also the engineering profession as a body on the many important undertakings which had been successfully carried out. He expressed his sincere regret that the Ontario Government had found it necessary to engage an American engineer for the Hydro-Electric Power Commission and believed that competent men could have been found in Canada. In closing he thanked the other officers for their valuable assistance and support and wished the Club every success in the future.

MR. C. B. SMITH,
President of the Engineers Club of Toronto.

CONCRETE DAM AT HESPELER, ONTARIO

We present herewith views of a concrete dam recently constructed for the R. Forbes Company at Hespeler, Ont. The bed of the stream at the site of the dam is a formation of hard unstratified limestone, forming an ideal sub-base for the concrete structure.

The old dam was a wooden structure with knee frames and stone filling and was thought to be unsafe, and also leaked and failed to hold the water at a time when most needed.

FIG. 1.—VIEW OF FACE OF R. FORBES DAM.

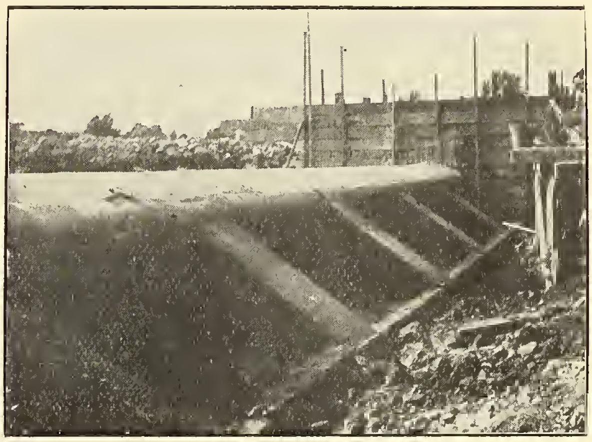
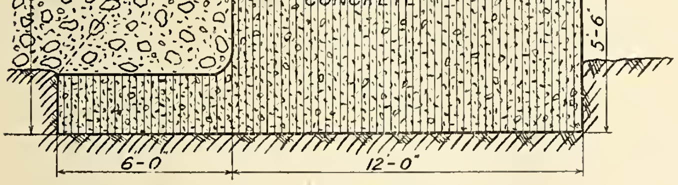


FIG 2.—UPSTREAM SIDE OF DAM BEFORE BACKED UP WITH STONE.

The new dam was built immediately below the old one, the latter serving the work as a coffer dam. The work was carried down to hard rock, all the weathered or deteriorated rock near the surface being removed. The depth necessary to secure a good bed varied from 18 inches to 6 feet.

The concrete used was in the proportion of 1 : 2½ : 5, with an addition of 20 per cent. of rubble stones in the interior of the mass. The aggregate used was pit gravel, from ground owned by the company, and sand was obtained by screening.



SECTION OF R. FORBES DAM.

The height of the dam varies from 12 feet to 8 feet. Fig. 1 shows a section of 10 feet 6 inches in height. The clear length of the spillway is 204 feet.

One abutment of an average thickness of 3 ft. 6 in. was built at the eastern end, up against the wall of the mill, and at the western end an abutment, 10 ft. in width, was provided with a 6 x 9 foot opening, controlled by stop-logs six feet in length, to enable the reservoir to be emptied when desired.

The design of the dam is by Mr. John S. Fielding, C.E., of 15 Toronto Street, Toronto, and contains a special feature in the use of an up-stream floor or toe, extending 6 feet under the reservoir, and loaded with the stone out of the old dam. The connection of this toe to the dam is increased by the addition of ribs, as shown in the up-stream view Fig. 2, the photo of same having been taken before the stone filling was placed in position.

During flood time the vertical pressure of the water on this toe is increased as the horizontal pressure on the up-stream face of the dam is increased, and in this way the safety factor remains satisfactory at all conditions of the flood. Mr. Fielding claims this device to be a distinct advance in the design of dams for low heads, and authorizes this journal to state that the use of the design can be had for the asking, although fully protected in the patent office.

Metal reinforcement was used in a horizontal plane at base of the dam, and also in the vertical and sloping faces, the total cost of such not exceeding $80, but giving an extra strength to the structure to resist temperature stresses, and to enable it to act as a unit. The total cost of the work, including the stone filling and the removal of the old dam, was $4,100, and one unique feature being that the engineer's estimate of 777 cubic yards as necessary to complete the work was only exceeded by 1 yard, the actual amount being 778 cubic yards.

The safety factors against sliding with a coefficient of friction of .65 are as follows:

Main portion with water at crest level	2.73
Total section with water at crest level	3.64
Main portion with 2-10 of flood	1.76
Total section with 2-10 of flood	2.465
Total section with 4-6 of flood	2.10

Messrs. Fraser & Eickle, of New Hamburg, were the contractors.

The committee appointed by the City Council of Halifax, N.S., to report on the feasibility of a municipal electric light plant are now enquiring into the available water powers in the vicinity.

Mr. H. P. Dwight, president of the G.N.W. Telegraph Company and vice-president of the Canadian General Electric Company, received the congratulations of many friends on December 23rd on attaining his 78th birthday. He was born at Belleville, Jefferson County, New York State, on December 23rd, 1828.

PARRY SOUND'S MUNICIPAL ELECTRIC PLANT

In May, 1906, work was commenced on the new municipal electric plant for the corporation of Parry Sound, Ont. Up to that time the corporation owned and operated an electric plant for supplying light and pumping water for the requirements of the town. The plant was situated on the Seguin River near the center of the town, a grist mill formerly being situated at this point. Both steam and water power were used for driving two 75 k. w. monocycle, belted type generators. The load on these machines so increased that early in 1906 the Council decided to build a modern electric plant, and Mr. T. T. Simpson, C. E., of Ottawa, was engaged to design the plant.

The new plant is situated on the site of the old plant which was removed, and new concrete dams have been built to replace the old timber dams which were in use for many years. The available working head at this point is now 25 feet, although during part of the year the head is 27 feet.

POWER HOUSE.

The walls of the power house are built of cement brick, which was manufactured in Parry Sound. This brick is laid in cement mortar. The roof which covers the building is made of reinforced concrete and is supported on steel I beams. Ample light and ventilation are provided for by the many large windows shown. The floor is of concrete as is also the platform on which the switchboard is mounted. The stairs leading to this switchboard platform are made of cement also. No wood is used in the building, which is fireproof, a saving of about $400 per year in insurance being made on this account.

DAMS.

As it was decided to largely increase the area of the fore-bay, it was necessary to build a side dam. This dam is built of concrete reinforced with steel rods. From the point where the side dam joins the main dam to the point where the flume commences is a distance of 180 feet. This side dam is built on bed rock, a suitable footing having been blasted out, and varies in height from 10 to 22 feet. A suitable sluice-way was left in this dam for emptying the pond when necessary.

The main dam is built of concrete and is 425 feet long. Openings are left in the dam for a timber slide and for a bulkhead. The bulkhead is built of timber and the rack of iron bars 3 in. x 3/16 x 18 feet long. This main dam replaced an old timber dam which had been in use for many years.

Fig. 1. - Main Dam and Part of Side Dam.

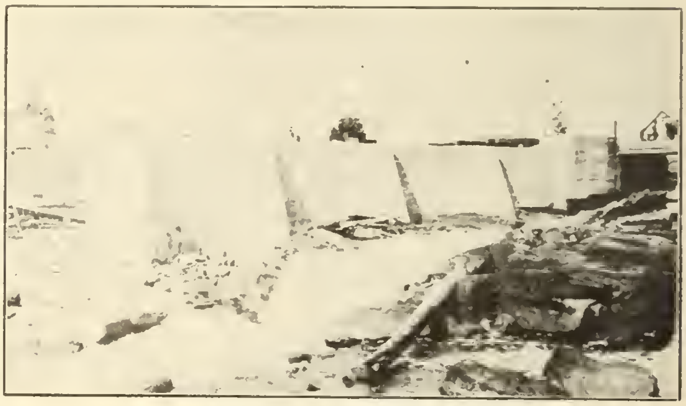


Fig. 2. - Upper Half of Side Dam.

ELECTRICAL MACHINERY.

The electrical machinery consists of one 425 k. w. three-phase revolving field type generator, frequency 60 cycles, voltage 2300, speed 200. The exciter is a 17 k.w. D. C. 125 volt generator.

SWITCHBOARD.

The switchboard is made up of one generator and exciter and two feeder panels. Mounted on the generator panel are the following instruments: One voltmeter, three ammeters, one voltmeter switch, generator and exciter rheostats, one oil break switch for controlling the output of the 425 k. w. generator, and one field switch with discharge clips. All the above mentioned apparatus was supplied by Allis-Chalmers-Bullock, Limited, Montreal.

Mounted on the feeder panels, of which there are two, are five D. P. S. T. 2300 volt Q. B. switches and one T. B. S. T. 2300 volt Q. B. switch for controlling the power circuit.

Connecting with each of the above switches are L. T. E. automatic 2300 volt circuit breakers, so arranged as to protect each circuit in case of any line troubles. Mounted on a swinging bracket is one C. G. E. frequency indicator. Lightning arresters are connected to each line on entering the power house. The arresters are of the standard General Electric type. The above mentioned feeder panels and lightning arresters were supplied by the Canadian General Electric Company, of Toronto. The switchboard is mounted on a concrete platform seven feet above the floor level.

THE TURBINES.

The water wheels, which are direct connected to the generator and exciter, were supplied by the Jenckes Machine Company, of Sherbrooke, Que., and consist of one pair of 38-inch Improved Crocker turbines enclosed in a steel penstock 11 ft. 6 in. in diameter. The wheels develop 750 h.p. under 25 ft. head, and are direct connected to the 425 k.w. generator. The speed is controlled by one Type "B" horizontal Woodward governor which is connected by a chain to the water wheel gate shaft.

Direct connected to the exciter is one 10-inch Crocker turbine revolving at 725 r.p.m. under a head of 25 ft.

Water is taken from the pond through a timber flume about 200 feet long. This flume is 12 ft. x 12 ft. at the entrance and 12 ft x 20 ft. at the lower end. A steel pipe 10 feet in diameter connects with the flume

through which the water is taken to the large wheels. A second steel pipe 24 inches in diameter connects with the flume through which the water is taken to the exciter wheel.

The power house is lighted by arc and incandescent lights so arranged as to best suit the requirements of the attendant.

Incandescent lights are in general use throughout the town and a day and night service is given. Power is supplied during the day time for operating induction motors throughout the town, many of which

FIG. 3.—EXTERIOR OF POWER HOUSE.

are now in use, and for pumping water for the municipal waterworks. A first-class service is given and the rates for power are low, and the Corporation are ready to make special rates to factories or other parties desiring to use power for manufacturing purposes. Parry Sound is situated on the Georgian Bay and possesses a first-class harbor with good shipping facilities. Connection is made with the Grand Trunk Railway and the James Bay Railway, and the new C.P.R. branch from Toronto to Sudbury also connects with the town.

The Council of 1906 was composed as follows: Mayor, J. A. Johnson; Chairman Electric Light Committee, F. Walton; Councillors, C. Gillespie, J. Argue, W. J. Jones, T. Perks, J. Purvis; Town Clerk, E. E. Armstrong.

MONTREAL

Branch Office of THE CANADIAN ELECTRICAL NEWS, Room B34 Board of Trade Building,

JANUARY 10th, 1907.

The Westmount Municipal Plant has been running their Magnetite arc lamps for some weeks, and up to date they have certainly been a success and are a vast improvement on the series enclosed type "alternating" arc which is in use in the neighboring city The current consumption is practically four amperes, which is a saving over the other arc mentioned, besides giving a whiter light of greater candle power.

There is considerable fooling being done somewhere in the iron conduit market, which with alleged shortage in pipe and consequent increase in prices will simply mean that some orders will be placed in England: and if so, it will be a sorry business for those on this side of the water so far as the contracting trade down east is concerned. The trade are just about furious as it is on the copper question, without seeing something else follow it without making a struggle.

The Montreal Light, Heat & Power Company are busily engaged with their new transmission line from Soulanges to Montreal. As this will pass close to the Lakeside villages of Ste. Ann.s, Pte. Claire, etc., it is likely that summer residents, who are numerous in that vicinity, may have electric power within the next two years for lighting, pumping water, etc.

The local press are agitating against the use of salt by the Montreal Street Railway. Anyone acquainted with our local climatic conditions will admit the fact that it is utterly impossible at times to run the street cars at all without the use of some salt. To prohibit its use would simply mean "to walk," but the Street Railway themselves might see that it is not quite so lavishly bestowed.

The trade in general, both supply and contracting, cannot complain of business offering during the holiday season. Although matters are slowly quietening down, as is their usual wont about this time of the year, yet on the whole trade is better than it generally is.

The manufacturers and dealers who are selling sockets surely cannot be waxing fat on their profits: it would look as if they will shortly throw in a Waterbury watch with each box taken. It is generally admitted that our American friends with their larger demand can make these items as cheap as Canadians (if not cheaper), but we do not find such prices floating in the neighboring republic. There are some other lines that might well come under this category also, and it is high time that the principal manufacturers, dealers and leading contractors should get together and establish a fair market value for staple lines.

The Montreal Light, Heat & Power Company have adopted the following regulations regarding motors, viz.: that all motors of 5 H. P. type and under be single phase, 110 volts, all above this 3-phase at 550 volts: Regarding lighting, mains to be brought out at the front of buildings. This latter regulation they have found necessary on account of the frequent suits brought by landlords for damages to roofs claimed to be caused by the erection of tripods. It is a matter of question whether these tripods have damaged roofs in many cases where so

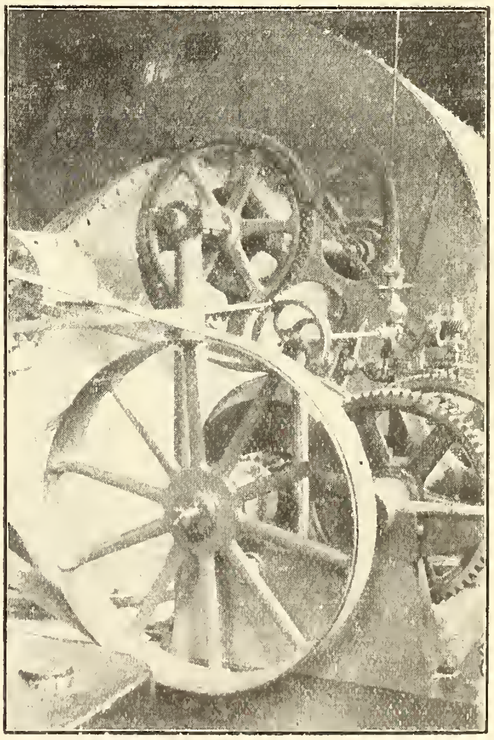


FIG. 4.—MAIN WATER WHEEL UNIT AND WOODWARD GOVERNOR.

claimed, but the landlord in Montreal is a curious person—if you DON'T shovel the snow off your roof and it gets damaged you are to blame, if you DO then he claims you have shovelled the gravel off and damaged it anyway.

During the holiday season we seem to have escaped the usual fires caused by cotton wool snow and Santa Claus with stuffed whiskers mixed up with small motors and series lights in show windows. This is probably owing to the fact that the better stores which can afford to make displays of this kind have realized that any such electrical work must be put in by an electrician, and have not used as heretofore a cloth cutter, furnace man, or some such to do the work.

CHANGES IN THE CANADIAN TARIFF.

The changes embodied in the new Canadian tariff will probably have a tendency to increase the prices of electrical apparatus and supplies, although not to the same extent, perhaps, as will the general upward tendency of raw material values. The tariff is made up of three sections, namely, the British preference, the favored nation tarriff and the general tariff. The British preference has been changed by the abolition of the 33⅓ per cent. discount and the substitution therefor of a special discount for each article. The favored nation tariff provides for special treatment to those countries which give Canada the benefit of lower duties.

The changes in the general tariff as compared with the former tariff on electrical apparatus, electrical and engineers' supplies, etc., are enumerated below:

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds, electric apparatus, n. o. p., and all machinery composed wholly or in part of iron or steel n. o. p. and integral parts of all machinery specified in this item, increased from 25 to 27½ per cent.

Brass, in bars and rods, in coil or otherwise, not less than 6 feet in length, and brass in strips, sheets or plates, increased from free to 10 per cent.

Brass and copper wire, increased from 10 to 12½ per cent.

Glass shades and globes, increased from 30 to 32½ per cent.

Manufactures of lead, increased from 35 to 40 per cent.

Switches, frogs, crossings and intersections for railways, increased from 30 to 32½ per cent.

Electric light fixtures or metal parts thereof, shade and shade holders, increased from 20 to 30 per cent.

Rubber belting, increased from 25 to 27¼ per cent.

Wood belt pulleys, increased from 25 to 27½ per cent.

Iron pulleys, reduced from 30 to 27½ per cent.

Boiler plates, changed from 10 per cent. to $7 per ton.

Babbitt metal, increased from 10 to 15 per cent.

Gasoline, reduced from 2½ per cent. to free.

The views of a few of the manufacturers and dealers in electrical apparatus and supplies was solicited by the ELECTRICAL NEWS and are printed below, the names for obvious reasons being withheld.

Generally speaking, there have not been very great changes in the duty on electrical apparatus. We are opposed, however, to the duty which has been imposed on brass sheet and brass strip, which cannot be obtained in Canada, and which is used largely in the construction of the goods we manufacture. There is no reason in our mind why this should not have been left on the free list as it was formerly. Another thing that we think should come in at 25 per cent. is rolled thread brass screws when used in the construction of electrical apparatus. The duty on the finished article is 27½ per cent., while the duty on these brass screws is 35 per cent.

From a manufacturing standpoint the tariff has done us more harm than good. We are manufacturing two articles upon which there used to be a protection of 25 per cent. and now the protection is 27½ per cent. Raw materials consumed in these articles which cost us 30 and 35 per cent.,now cost us 32½ and 37½ per cent. duty. So far as we are concerned the present tariff arrangement is worse than useless to us. We get no protection, as the duty on our raw material is much greater than on the finished product. With regard to electrical supplies the increased duty appears to be a hardship, as 90 per cent. of the supplies stocked are imported and not made in Canada.

The import tariff of 10 per cent.on brass rods and sheets will most probably cause an increase in the cost of all brass goods and fittings for use in connection with electrical apparatus.

In the lines in which we are principally interested, the changes embodied in the new tariff are altogether unnecessary and uncalled for. Why, for instance, should electric light shades (made principally in Bohemia) be made dutiable at 32½ per cent., an advance of 2½ per cent., although there is absolutely nothing in the way of a competitive article or even of a glass shade of any kind being made in this country. The same query is in order in regard to nearly all small electrical supplies which have been made dutiable at 27½ per cent.—an advance of 2½ per cent., although under the former tariff of 25 per cent. a number of factories had sprung up in various parts of this country and are all apparently thriving and daily extending their business. We note also that electric light carbons, which are used throughout this country in every town and village in which modern appliances have been adopted, are still assessed at 35 per cent., although there is not a single arc light carbon made in the country. If these advances have been devised simply and solely for the purpose of raising revenue, then the matter might be understood, but not otherwise.

The changes in the tariff will affect the selling prices on electrical supplies to quite a little extent, as the 10 per cent. duty on sheet brass has to be added to the cost of this material. Also, the advanced protection of 2½ per cent. is not sufficient to cover the advanced duty on brass. This, of course, would not be objectionable if there were any persons manufacturing brass in Canada, but whereas there is not, it is natural that we have to consider it as not just until such time as somebody starts up a brass mill on this side.

PUBLICATIONS.

Much information concerning the "Victor" porcelain insulators is to be found in the 1907 edition of "The Insulator Book," published by the Locke Insulator Manufacturing Company, Victor, N. Y.

Catalogues have been received from the Rockwell Engineering Company, 26 Cortlandt Street, New York, describing their fuel oil burning appliances, annealing and hardening furnaces, heating machines for annealing, hardening and tempering, fuel welding furnaces, etc.

Frederick J. Drake & Company, Chicago, have issued a very useful book, entitled "Electrical Wiring and Construction Tables," the authors being Henry S. Hortsmann and Victor H. Tousley. The book contains tables for direct current calculations, tables showing the smallest wire permissible with any system or number of h. p. or lights under National Electrical Code or Chicago rules, and much other valuable information bearing upon electric wiring. The price of the book is $1.50.

The Westinghouse Diary for 1907, issued by the Canadian Westinghouse Company, is as usual very complete and contains much information of value to electrical people. In it are found tables of dimension, weights and resistance of pure copper wire, tables of carrying capacity of copper wires and cables, comparison of copper and aluminum, horse power of belting, rules for pulley sizes, and much information regarding the operation of steam turbines, gas power stations, electric railways, Nernst lamps, etc.

Mr. Charles Brandeis, of Montreal, has been appointed consulting engineer to the Minister of Public Works and Labor of Quebec, and has been instructed to report on the best system of electric light in connection with prisons. In this connection he will visit the principal cities in the United States.

The Berlin Electrical Manufacturing Company, Toronto, Ont., have received their charter from the Ontario Government. This concern, having been changed to a joint-stock company, will transact their business under the name of the Berlin Electrical Manufacturing Company, Limited. The provisional directors are D. E. Brand, L. Pollock, L. Willich, D. Brand, and W. M. Cram.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

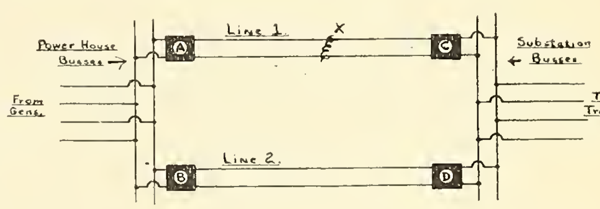
1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.

Question No. 1.—Can you tell me why gaps are used in lightning arresters? I would be inclined to think that a high resistance path to ground would offer an equal, if not better, protection.

Answer.—The result of many experiments, conducted in all parts of the world, shows that the gap is a much more satisfactory scheme for general use than any other system of lightning protection. Certain arresters are made where a continuous path to ground is offered, and while such devices are entirely satisfactory for the peculiar conditions under which they are intended to operate, still they are not applicable to general service. The protection of electrical apparatus against damage by lightning is one of the most complicated and least understood branches of the art, and a type of arrester which will give satisfactory protection under some conditions, is not in the least efficient when operated under conditions which, to the average electrician, may seem entirely similar. For alternating current service, where the potentials exceed one thousand volts, it is almost universal practice to adopt a lightning arrester which has an air gap in its make-up, and we are safe in saying that probably over ninety-nine per cent. of all arresters in use at the present day are of this type. It is not difficult, as you will understand, to provide a path to ground for a lightning discharge, but the sticking point is always to make this path of such nature that a high resistance is offered to the current of the generator. The old type of saw tooth arresters had a fuse in series, and this fuse would be ruptured on each lightning discharge, and therefore required replacing immediately after the occurrence of such discharge. This arrangement is manifestly a poor one, as any efficient lightning arrester must be of such design as to be able to take care of discharges following each other in rapid succession, without any intermediate manual adjustment of its parts. The old idea of breaking the dynamo current which followed a lightning discharge, by means of moving parts, has been pretty well discarded in all but one or two well known classes of arresters. In these the movements are so simple and reliable that the device can be considered as entirely satisfactory. The simplest form of arrester, of course, is that type in which are incorporated the so-called "non-arcing" electrodes. This class consists of a series of air gaps of proper length formed between electrodes of non-arcing materials, it having been discovered by Mr. A. J. Wurts that an alternating current arc cannot be maintained between terminals consisting of certain metals. With such a solution of the problem before us, you will appreciate that the gap arrester has certain material advantages, probably the greatest of which is the fact that it insulates the lines from the ground, meaning of course that there is no loss of current to the earth, such as occurs with the permanent passage arrester.

Question No. 2.—Will you kindly explain the functions of what is known as a "reverse current relay?"

Answer.—In all large power equipments continuity of service is an essential feature, and hence it is necessary to incorporate various devices which tend to cut out lines which are producing trouble, and also to prevent the cutting out of lines which are free from trouble. For information on one of these devices, we would refer you to Question No. 1 in our August, 1906, issue, which deals with time limit relays. The reverse current relay has its application chiefly where two transmission lines are being operated in parallel. In all large equipments it is customary to have both lines in constant service so that in the event of trouble occurring on one line the other will continue to supply energy to the sub-station. It will be assumed that both outgoing lines at the power house are equipped with circuit breakers controlled by time limit relays, and that where such lines enter the substation they are provided with circuit breakers controlled by reverse current relays. The following diagram will give you a good idea of the use of this class of apparatus.



Let A and B represent circuit breakers in the power house equipped with time limit relays, and C and D circuit breakers in the sub-station equipped with reverse current relays. We assume that both lines are being operated in parallel, and for the sake of simplicity the system has been drawn as a two wire arrangement. If a short circuit should occur at the point indicated by "X" on line 1, current will flow from the power house through line 1 to the point of short circuit, and also through line 2 to the sub-station, and back through line 1 to the same point. It will therefore be seen that to clear the system of this short circuit, circuit breakers A and B would have to open, unless there were some device in the sub-station such as circuit breaker C, which would immediately open and allow circuit breaker B to stay closed and thus continue to supply current to the sub-station. Circuit breaker C, however, as before stated, is controlled by a reverse current relay, and as soon as the current changes its direction and commences to flow from the sub-station along line 1 to the point of short circuit, it immediately opens and thus line 1 is disconnected both at the power house and at the sub-station, while line 2 is left in operation. The reverse current relay usually consists of an ordinary fan motor, the field of which is fed from the secondary of a potential transformer, and the armature of which is fed from the secondary of a series transformer. You will thus understand that when current is flowing in the proper direction the tendency of the fan motor armature is to revolve in a certain way, and that should the flow of current in the line be reversed, the fan motor will tend to revolve in the opposite direction. Very little movement, however, is allowed the fan motor armature, this movement being controlled by stops. No action takes place when the direction of rotation is normal, but when this direction is changed, owing to a reversal of the current in the line, two contact points are brought together, and the circuit controlling the tripping coil of the breaker is closed, and hence the breaker operates.

Electric Meter Inspection and the Need of a Standardization Bureau

An examination of the annual report of the Inland Revenue Department shows that the Dominion Government is now deriving considerable revenue from the inspection of gas and electric light, the actual amount for the last fiscal year being $37,621.52, made up of $12,375.99 from gas inspection and $25,245.53 from electric light. In view of the large surplus, the publishers of the CANADIAN ELECTRICAL NEWS addressed the following letter to a number of the electric lighting companies :

TORONTO, December 28, 1906.

DEAR SIRS:—According to the last report of the Inland Revenue Department of Canada, the revenue derived from the inspection of electric light during the fiscal year ended June 30, 1906, was $35,099.75, while the expenses, including the purchase of standard instruments, were $9,854.22, thus leaving a net revenue of $25,245.53.

In view of the large excess of receipts over expenditures, do you consider that the Government should reduce the fees for the inspection of meters, and to what extent ?

Are the present methods of inspecting and testing meters satisfactory and equitable to the electrical companies ? If not, what changes should in your opinion be made ?

Very truly yours,

THE C. H. MORTIMER PUBLISHING CO., LIMITED.

The replies received are published below, and we shall be glad to have the opinions and suggestions of other companies or persons who may be interested in the subject.

Replying to your letter of December 28, I would say that in view of the large profits from the inspection of electric meters, we are entitled to have our burdens reduced.

The inspection was intended by the Government to be self-supporting, but I do not think it was ever intended—nor should it be—a source of revenue, or means of taxing electric companies. Notwithstanding that we buy the best meters, regardless of price, we find it necessary to break the seals sometimes and to have interim tests. This is especially true of direct current meters having computator and brushes. The interim verification costs less than the regular, it is true. The trouble is that the regular inspection fees are too high. We have, in addition to that, the registration fee. We have to furnish the office of the Inspector with necessary current for testing, and we must bring our meters to him and take them away at our own expense, so that the total cost is considerable. We also have to suit the Inspector's convenience as regards testing, although of this I would not make a complaint.

It is strange that the gas meters are sealed in such a way that the owners are not prevented from opening them and altering them if they should desire, but they will not allow us to open the direct current meters to clean them without re-verification, and another fee.

There is a feeling about, that the Government should provide means of testing and calibrating instruments of precision, as is now being done by the American Government, and has been done for years by European Governments.

The Canadian Electrical Association might well take up the question and decide whether to ask for a reduction of fees or for more accommodation from the Government in the way of testing facilities.

You are aware that if we need an instrument calibrated or test confirmed on a transformer, incandescent lamps, etc., we have to send to the manufacturer of the instrument across the border at a considerable annoyance and expense, owing to customs regulations, or to some private testing bureau in the United States, whose decisions are not official and fees fairly high, or we must go to a College like McGill, or Toronto, and ask, as a matter of favor, to have some tests carried out for us. In many other departments of Applied Science similar difficulties are met with.

Personally, I think the Government should give us the verification of meters and all the testing facilities at net cost.

A. A. DION,

General Superintendent Ottawa Electric Company.

The system is not so bad, but the charges are certainly most excessive. For the first year or so after the Electric Meter Inspection Department was established the revenue was very small, on account of the few meters then in use, but time has made a wonderful change in this respect. Nearly every electric company has adopted the meter system of selling current, and consequently the number of meters sent to the meter inspector's office for inspection has increased enormously and a large revenue has been received, which is far in excess of the cost to the Department having this matter in charge.

When the electric meter inspection system was first started we were informed that as soon as the revenue warranted it, the schedule of charges for inspection would be reduced. I certainly think that that time has arrived and the Government should reduce the inspection fees to the lowest possible figure consistent with the cost to the Department, and all interim tests should be made free of charge, unless the meter is found to be out of order ; then the usual fee for inspection might be made, after the meter has been put in proper working order.

This matter should be taken up by the Executive of the Canadian Electrical Association at once, and proper representation made to the Government at Ottawa, who will, no doubt, see the injustice of the present scale of fees charged for electric meter inspection.

CHAS B. HUNT,

Manager The London Electric Co., Limited.

It certainly does not look right that electric light companies should pay more for the inspection of meters than actual cost, and the Government should reduce the fees to at least near the actual cost.

The present mode of inspection seems to be quite satisfactory and fair to all concerned.

WM SNIDER,

Waterloo, Ont.

With reference to your letter of December 28th, in regard to the net financial results, as indicated by the last report of the Inland Revenue Department of Canada, resulting from electric light and meter inspection service for the year ended June 30th, 1906 :

In view of the figures that you quote, it is certainly apparent that the Government should make a considerable reduction in the inspection fees. It would appear that these fees could be reduced by 50% and yet leave a handsome profit for the Government from the service. As regards the methods of inspecting and testing meters, these appear to be as satisfactory and equitable as can be expected, i.e., from the Company's standpoint.

THE MONTREAL LIGHT, HEAT & POWER COMPANY,

J. G. Morris, Secretary-Treasurer.

I have your letter concerning the inspection of electric meters, and am pleased to know that you have taken sufficient interest in this matter to discover what returns the Government receive from the lighting companies.

You ask the question "should the Government reduce the fees for inspection." My answer is decidedly "yes." I do not think the charge should be more than 50 cents for any meter, no matter what its capacity is.

You ask if the inspection, under present methods, is satisfactory. I would say that so far as the inspection goes it is no indication that the meter is correct. My experience has been that the inspection takes about one minute per meter.

Meters should be tested on no load, minimum load, half load and full load and a special form issued by the inspector in the form of a card which can be filed away for reference. The card should show the percentage fast or slow, as the case may be, on the several loads upon which the meter was tested.

The inspector should be a man whose education and electrical

experience would enable him to undertake the tests of the numerous makes of meters in use and assure the companies that his reports are absolutely correct.

These suggestions may not be of value to the large companies who have a sufficient number of meters in use to make it a paying proposition to retain the services of a special meter man who makes it his daily duty to test so many meters from January to December, but for the smaller companies who depend upon the tests made by the Government Inspector, I think the present practice can be much improved by following the suggestions offered above.

Trusting that this may be of assistance to others in the business.

I. H. Wright,
Manager North Bay Light, Heat and Power Company.

In view of the large excess of receipts over expenditures the Government should reduce the fees for the inspection of meters at least 50 per cent.

I might say that I know a number of people in this Province who give their customers what is known as a flat rate in order to avoid the high charges for inspection of meters.

I am satisfied in my own mind that if this were done it would not lower the revenue very much, as there would be a great many more meters put on.

Brampton Electric Light Co.,
John McMurchy, Proprietor.

I do not consider the present fees for testing meters onerous to any electric lighting companies, but I do think that the net revenue should be used to a great extent in improving the conveniences for testing the electrical standardization for the use of the public who supply this large revenue. I consider that the meter inspectors should be men qualified for the technical side of their work; that standard instruments should be located in various centers throughout the Dominion, and a regular system of checking these standard instruments should be carried out, so that we may be able to procure standardization reports without being under the obligation of applying to McGill or any other University for such reports for those instruments which electric lighting companies term their standards.

I am of the opinion that the net revenue of $25,245.53 could be well employed in improving the efficiency of the department.

Donald S. Barton,
General Manager and Chief Engineer Canadian Electric Light Company, Levis, Que.

We are in receipt of your favor of the 28th inst., regarding the inspection of electrical meters. As we do not use any, it is immaterial to us what their charge may be, although, on the face of it, it looks as if the electrical people had a big kick coming, as the intention of all inspections for Government purposes is simply to protect the people, not to make money for the Government.

W. H. Meldrum,
Manager Otonabee Power Company, Peterboro, Ont.

In reply to yours of 20th ult., re. electric meter inspection, I think in view of the fact that the revenue from that source shows a surplus of over $25,000 for the past year, the Government should be petitioned to lower the fees to be on a par with gas meters, say $1 for 10-ampere meters, and abolish the registration fees. Then there is great need for a standardizing bureau for testing and calibrating all kinds of electrical instruments, testing lamps and other electrical apparatus, to be run by the Government, and for which a nominal fee might be charged.

W. Williams,
Manager Sarnia Gas and Electric Light Company.

In view of such large profit by the Inland Revenue, I am of the opinion that fees for the testing of meters, etc., ought to be reduced to at least half. I cannot understand why the Government wants to make such large profit out of the electric light companies, as you are aware that we have to fight our customers to get a bigger price for our lights, and the net profit is very small. There are a great many companies that are not getting anything fair for their investment. Trusting that you will get the present inspection system altered.

J. A. Thibodeau,
Manager Pembroke Electric Light Company.

Re. charge for inspecting meters would say that I was always of the opinion that the charge was unduly high. If the price were reduced 50 per cent. it would be ample to cover all Government expenses and still leave a very considerable surplus and would not be such a charge on the companies.

A. A. Wright,
Renfrew Electric Light Company.

We are perfectly satisfied with the present method of inspecting and testing and think that they are both satisfactory and equitable to the companies. However, if the revenues are so much in excess of the expenses there is no reason why the Government should not make a reduction of at least 50 per cent. of the present fees. This would still leave a surplus and the increase of business would make a still further increase to the revenues derived from this source.

James Anderson,
Manager Sandwich, Windsor and Amherstburg Railway Company.

As far as we are concerned we find the present method of inspecting and testing meters quite satisfactory, but we would be very glad to have the cost of same reduced. From the figures you have supplied us with it appears to us this can be done and we certainly would give our support to any movement which would bring this about.

The Peterboro Light and Power Company,
J. H. Larmouth, Manager.

I have not had an opportunity of verifying the figures mentioned by you, but if as you say the revenue derived by the Inland Revenue Department of Canada from the inspection of electric light during the year ended June 30th, 1906, was $35,099.75, while the expenses were $9,854.22, I certainly think a reduction in the charge for meter inspection should be made. If the bulk of the revenue is derived from meter inspections, I am of opinion that the fees should be reduced by 50 per cent.

Electrical companies already bear their full share of taxation and while it is perhaps just that they should bear the cost of meter inspection, there is no reason why they should have to pay more for inspection than it costs.

We are quite satisfied with the methods of inspection and testing in use in Vancouver, which are carried out fairly and in the interests both of the public and the company. The only event of an unsatisfactory nature was a case where a meter had most evidently been tampered with. The fact that a hole had been driven through it and a chemical poured in which clogged it and prevented it from registering was not considered to be evidence sufficient to convict the householder, and this being so we are practically unable to secure a conviction in a case where a meter is tampered with.

R. H. Sperling,
General Manager British Columbia Electric Railway Company, Vancouver.

What little lighting we do is on a flat rate basis, but it seems to us that the net revenue received by the Inland Revenue Department of Canada is beyond reason.

L. A. Campbell,
Manager West Kootenay Power and Light Company, Rossland, B. C.

I have always considered the fees for the inspection of meters too high, and it is not intended by the Government to be so much out of proportion to the service. The demand for meters has increased so much since 1897 that the Government may now see their way to lower the fees. I would say the fees could be made: 10 lights, 40 cents; 20 lights, $1.00; 30 lights, $1.25; 45 lights, $1.50; 60 to 100 lights, $2.50.

A. Sangster,
Superintendent Sherbrooke Power, Light and Heat Co.

THE TREATING OF TRANSFORMER OIL

S. M. Kinter, in The Electric Journal.

The successful operation of the higher voltage transformers depends very largely on the condition of their insulation. As all transformers of this class are oil insulated and rely to a considerable extent upon the oil for their insulation, it is of the utmost importance that the oil should be in prime condition. The condition of the oil is of more and more importance as the voltages are increased.

It is generally known that the presence of water in oil is detrimental to its insulating qualities, yet it is hardly appreciated how slight an amount of water or moisture is required to very materially reduce the dielectric strength of oil. Mr. C. E. Skinner, in an article in the May, 1904, issue of The Journal, called attention to the extreme sensitiveness of oil and gave a curve showing dielectric strength for various percentages of moisture. It will be noted on reference to this curve that 0.04 of one per cent. moisture, or four parts in 10,000, is sufficient to reduce the dielectric strength of the oil one-half. The experience of the writer indicates that oil is even more sensitive to change than stated by Mr. Skinner. There have been a number of instances where careful chemical analysis failed to show the presence of moisture, when an electrical test indicated its presence, this last fact being established by re-testing the oil after the removal of the moisture.

It is hardly necessary to dwell at any length upon the many ways in which oil can accumulate water and moisture, as these are generally known. The question, however, that frequently confronts the operating engineer is how to remove the moisture from his transformer oil.

It is a simple matter to tell whether the oil has moisture provided there is very much water present, as it will readily settle out in the bottom of a sample drawn from the lowest point of the transformer. Another test that is more sensitive, and is in fact amply sensitive for a large majority of cases, is to thrust a red hot nail or rod into a sample of oil under test. If the oil "crackles" like frying grease, water is present. In the absence of moisture there will be no crackling sound when the rod is thrust into the coil. In the electrical test of dielectric strength average dry oil should not be weaker than 30,000 volts as the mean of ten tests for a 0.15 inch gap between one-half inch spheres. The oil should not break below 25,000 volts in any of the ten tests.

There are six ways of effecting the separation of oil and water, (1) mechanical separation, (2) capillarity, (3) electro-static force, (4) heating, (5) vacuum and heating, and (6) dehydrating.

MECHANICAL SEPARATION.

When the oil contains considerable water or moisture, its greater density will cause a separation between the two materials, the water settling to the bottom. After this separation, the excess water can be readily drawn off. The same separation can be effected by passing the material through a centrifugal machine. The water in this instance will settle to the outside and can be drawn off. As the amount of drying that can be effected in this way is not sufficient for the higher voltage work this separation needs to be followed by some other more complete method of drying.

CAPILLARITY.

During the development of an oil-treating outfit, the fact was noted that certain materials had the property of allowing the water to pass through readily but still interfering with the passage of oil, this action being due, it is believed, to the difference in capillary attraction of the two materials. This fact has been made use of in a form of a separator which allows the passage of water and still retains the oil, this separator being in the form of a disc and placed so that all water and oil passing to the treating outfit passes over the disc. The disc allows the separation of the excess water and consequently relieves the treating outfit of a certain amount of work. The separation that is effected by this method is, however, of the same order as that mentioned under the heading of "Mechanical Separation," and the oil needs further treatment before it is sufficiently dry for good electrical service.

ELECTRO STATIC FORCE.

An intense electro-static field can be so arranged that it will tend to hold the water, and impurities of higher specific inductive capacity than the oil, in its denser field. This effects a certain separation, permitting the dry oil of lighter specific inductive capacity to pass to the weaker side of the field. By drawing off the oil from these several points, it is possible by repeating the process several times to effect a drying of the material. Tests that have been made on this method, while indicating the possibility of its being used, have not shown it to be entirely satisfactory. As a rule, it will be found quite difficult to operate such an arrangement, and it is on the whole not to be recommended.

HEATING.

Moisture can be removed from oil by direct application of heat. This can be brought about in several ways, one of the most common of which is to immerse in the oil grid resistances which are heated electrically. The oil as a whole has its temperature raised slightly above the boiling point of water and it is maintained at this temperature until all the moisture is boiled out. The grid resistances should be placed at the lowest possible point in the oil, as otherwise all oil below these resistances will remain cold and there will be an accumulation of water at this point, with the result that if all of the oil is drawn off at the end of the drying, this mois-

ture will be mixed in with the oil that has been dried above the grids. It is much better, if possible, to so arrange the drying tank that the heat is applied below the tank. In this manner, all of the oil that is being dried is subjected to the heat. It is necessary to maintain a temperature of 105 to 110 degrees C. and this will have to be maintained until tests show that the oil has been entirely freed from moisture. As a rule, in drying large quantities of oil, this will require from ten days to two weeks heating. The continued heating of the oil at this temperature will prove very detrimental to the oil. It will tend to break it up, separating the lighter hydro-carbons and causing certain formations in the oil due to this separation. Oil that has once been overheated in this manner is apt to continue to develop this formation when put in service and operated at lower temperatures. The oil will be very greatly changed in color, being very much darkened. On account of the change in the oil, this method is not looked upon with much favor, and should be used only in such cases where other apparatus for drying the oil is not available.

Another method of applying the heat that is sometimes employed is that of blowing hot air through the oil. In doing this it is necessary to be sure that all moisture is removed from the air that is being blown in, as otherwise the hot air will carry in moisture and condense it in the oil, thus adding to the amount of moisture in the oil rather than taking it out. This method is open, of course, to the same objection as that raised to the above, that of causing decomposition of the oil. It is believed to be somewhat worse than direct heating, as the great amount of air blown in will cause a certain amount of action which is apparently a form of oxidation, and will aggravate the decomposition of the oil and the settling out of the lighter hydro-carbons.

VACUUM AND HEATING.

It has been found possible to dry oil by the use of a vacuum tank, heat being applied to the oil at the same time. The use of a vacuum lowers the boiling point of the water and consequently makes it possible to eliminate the moisture without reaching a temperature that is detrimental to the oil. This method, where available, should prove satisfactory, and it is possible to secure an oil that is perfectly dry by this treatment. As a rule, it will require considerable time to thoroughly remove the moisture, and for this reason the method is not as convenient as the one described below.

DEHYDRATING.

Moisture can be removed from oil very rapidly and very cheaply by the employment of suitable agents for absorbing the moisture. The engineers of Westinghouse Company have developed a treating outfit which employs this principle, in conjunction with method (2) described above. This outfit circulates the oil to be dried through a treating tank in which is placed a dehydrating material. The oil after passing through this dehydrating chamber is filtered and thus all foreign materials that are in the oil, as well as any of the dehydrating material that may have followed through, are removed. It has been found possible with an outfit of this kind to dry a thousand gallons of oil in a day, and to have this oil as dry as required for the highest voltage service. Lime is the material employed in the dehydrating tank. This material has been selected after testing a number of dehydrating agents, as it is usually available and introduces no possibility of injuring any part of the transformer if any of it gets through the filter with the oil. It has the additional advantage of tending to neutralize any acids existing in the oil. A number of other satisfactory dehydrating agents have been used and in some instances where special precautions are observed it may be found more advantageous to employ some of these than the lime. Dry sand has generally been used for the filtering material, although in some instances it has been found advantageous to mix in certain proportions of bone-black and Fuller's earth, these last two having the property of tending to clear the color of the oil. As a rule, dry sand will be found sufficient.

It is the writer's opinion that the last method mentioned will be found much superior in general practice to any of those mentioned above. The outfit that has been developed is sufficiently portable to permit of its being readily shipped from one station to another, and it is a compact unit in itself, being provided with a motor and pump, together with the necessary filtering and treating tanks, and accessories. This outfit when placed in service, and intelligently operated, has proven entirely satisfactory. The oil should be tested from time to time to see that the dehydrating materials have not depreciated in strength. When the oil indicates this fact, it is necessary to re-charge the apparatus. No statement can be made as to how much oil can be treated with one charge, as this is dependent upon the amount of moisture held in suspension in the oil, which will vary with different oils and temperatures. It is quite probable that the companies operating the extremely high voltage transmission systems will find it necessary to treat the oil used in the transformers, switches, etc., periodically, so as to insure its being in the best possible condition. For such treatment as this, an outfit of the kind just described is very effective.

In specifying temperature rises of 70 to 80 degrees Fahrenheit for electric generators and motors, engineers are no doubt governed by the consideration that the cotton covering on wires begins to carbonize at about 255 degrees Fahrenheit, and that internal maximum temperatures are higher than those indicated by the thermometer. Even though the insulation be of mica, or other heat-resisting material, the dynamo is essentially a piece of apparatus the temperature of which must be kept low. But a rheostat, though not always used directly with that intention, is an appliance for dissipating energy. When properly designed, it has nothing whatever inflammable in its construction and it should be so placed that there is nothing inflammable in proximity.

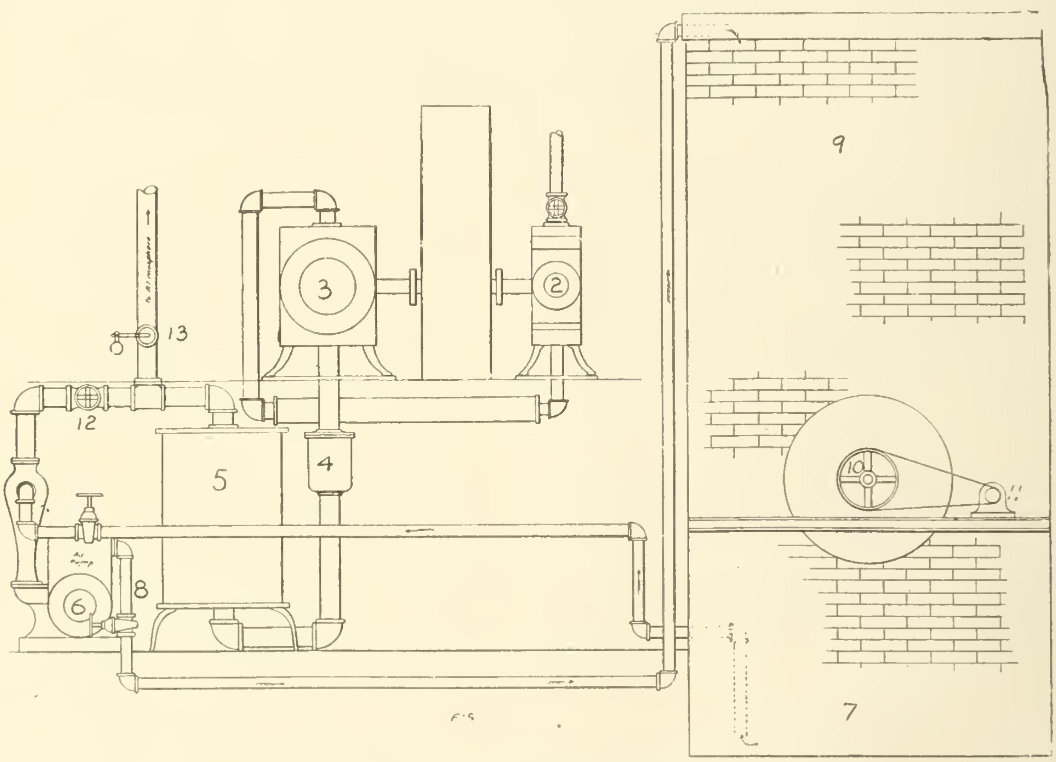
AN ECONOMICAL STEAM PLANT

By W. H. Wakeman.

Much is said and written at the present time concerning the economy of gas engines, especially when they are driven by gas made in a producer on the premises. This is perfectly legitimate and proper, but in many cases very unfair comparisons are made between this comparatively new power and the older form that is driven by steam. If a steam plant is properly designed for its load, fitted with all modern appliances for saving coal and operated by a skilful engineer, there will be but little difference in favor of the gas plant.

When boilers are so small that it is necessary to force them to their full capacity in order to get steam enough to run the engine and sup that which is wanted for other purposes, and there is consequently no spare boiler to use while one of the others is laid off for cleaning and repairs, the best results from fuel burned cannot be expected, as a constant waste must result. It is true that the most economical results are not secured where the rate of combustion is very low, but where there are more boilers than are actually required, it is an easy matter to lay off one of them, but where there are not enough when all are in use, the engineer has no choice in the matter but must make the best of a bad situation.

As there are five boilers in my plant and only two are required in warm weather, three are used when it is a little colder, four are needed when ordinary cold weather prevails and five are put into service during severe weather, it affords a good opportunity to operate boilers to their best possible advantage, and this is done at all times.



Arrangement of an Economical Steam Plant.

The illustration shows a steam engine that uses steam to the best possible advantage, and is recommended accordingly. It is generally considered that it only pays to install such an engine for large powers, but it will probably result in satisfactory service if as low as 300 horse-power are used, and if fuel is high it may be wise to use it for even 200 horse-power.

This engine and its accessories may be described as follows: Steam is generated at not less than 125 pounds pressure, and 150 is better if the load warrants it. The high pressure cylinder 2 receives it first and after being used to good advantage here it is exhausted into the low pressure cylinder 3 where it is further expended until the economical limit is reached. It is then exhausted through the oil separator 4 where nearly all of the cylinder oil is removed. This does not mean that one-half of it is taken out, but that not less than 98 per cent. of it goes to the sewer where it can do no harm. The purified exhaust steam then passes through the heater 5 raising the temperature of the feed water to 130 degrees Fah. As some of the steam is condensed in this process, it leaves less to be disposed of by the jet condenser 6 which receives it next. A vacuum of about 28 inches is maintained here which means that the large low pressure piston has to force steam out against about 2 pounds absolute pressure, instead of 15 pounds or more where an engine is run non-condensing. As the jet condenser can do this at less cost than if it had to be done by the engine itself, it proves a paying investment where the exhaust steam cannot be used for other purposes to good advantage. In places where large quantities of water must be

heated for manufacturing purposes, the heater may be made large enough to do this work with exhaust steam, instead of using live steam for this purpose, according to the custom adopted in some places. It usually takes about 25 times as much water to operate a condenser as it requires to feed the boilers, and of course this must be pumped by the air pump (where a jet condenser is used). In this case it is taken from the reservoir 7 by the suction pipe, as indicated by the arrows. After doing the required work it is discharged through 8 into the cooling towers 9, where it is cooled until it is right for use again.

This is accomplished by forcing a large volume of air up through the tower by means of the fan 10 that is operated by the electric motor 11, where current is available for this purpose. If electricity is not generated on the premises for other purposes, it will probably be advisable to use a small steam engine for this purpose, rather than to buy current from other parties, and if the plant is located where current cannot be purchased it will be necessary to provide power for the fan. An independent engine is recommended for this purpose, rather than power taken from a countershaft that is run by the main engine, as its speed can then be varied to suit the load and other conditions. It can also be run to cool the water when the main engine is shut down, which is a valuable feature.

As already mentioned, it requires about 25 times as much water to operate a condenser as to feed the boilers where a condenser is not used, and this water must pass through the air pump of a jet condenser every hour. If a cooling tower (or other device for cooling this water) is not used, then it must be supplied from brook or river constantly, but where a good cooling tower is installed much water is saved, as it is used over and over again. There is some loss attending this process because a portion of the hot water as it is delivered to the tower passes into steam which floats away and is lost.

However, the small amount thus wasted is less than would be required to feed the boilers if the plant was run non-condensing. This shows that if a plant is located on a river or brook a condenser can be used to good advantage, as it will reduce the coal consumption about 25 per cent., without the use of a cooling tower, but if it is located where a large supply of water is not available, the installation of a cooling tower will make it possible to secure all advantages of a condenser with a limited supply of water.

Steam users find the cost of running a plant quite heavy at times, and when some other form of prime mover is suggested they are ready to consider its merits, which is proper, but we advise that all known appliances for saving fuel be given a fair trial, before a steam plant is condemned as too expensive to be operated for manufacturing purposes.

When installing a plant of this kind there should always be a valve in the exhaust pipe, as illustrated at 12, so that in case of accident to the condensing apparatus, this valve may be closed and the relief valve 13 opened, thus letting exhaust steam go to the atmosphere until the condenser, or whatever part of the installation was out of order can be repaired and put into service again. This relief valve should always be in the form of a back pressure valve for a non-condensing plant, so that it will open automatically in case the condenser fails to work properly for any cause.

We urge every steam user who feels the cost of power a burden, to carefully consider these propositions for saving fuel, and wherever practicable to adopt them at once.

EXTENDING THEIR PLANT.

An indication of the present growing time in Canada is the fact that all industrial establishments are crowded to their utmost capacity, largely due to the great activity in railroad building, the development of our natural resources, and the great increase in population by immigration.

The Canadian General Electric Company and the Canada Foundry Company, in anticipation of this industrial awakening, which they foresaw, only recently completed extensive additions to their plants at Peterborough and Davenport, and are now again building large additional shops at each of these places. That their foresight was warranted is evidenced from the fact that one of the directors of the company has stated that the week ending Dec. 15th was the banner week in the company's history, as contracts for upwards of nine hundred thousand dollars of miscellaneous machinery and supplies were secured during that week.

COLORING ELECTRIC LIGHT BULBS.

First mix the white of one egg, previously beaten to a frosting, and one pint of soft water. Strain through a very fine sieve, and make sure that no bubbles remain on the surface of the liquid. The globe should be carefully cleaned and polished, and then dipped into the mixture and hung up on a string to dry. After about half an hour they should be dipped the second time, to insure a perfect coating. When perfectly dry they are ready to be colored. For this, dissolve ten to thirty grains, according to the density of color desired, of any powdered dye in four ounces of collodion. Dip the globes in this and hang up to dry. If not dark enough, after about six hours, when they are dry, dip again. This coating will never crack or peel off. The best container for mixing the fluid is a baking powder or similar can, just a little larger around than the globe. This requires less of the mixture to make enough to cover the globe.

An electric lighting plant operated by wind power has recently been installed at Noblesville, Ind., and is reported to be giving entire satisfaction. It consists in part of a 14-ft. windmill on a 50-ft. tower. This drives a plunger pump which delivers water to a reservoir in which a constant pressure of 75 lbs. per sq. in. is maintained by weights mounted on a plunger in the reservoir. This water, under pressure, is used when necessary to drive a 1-2-HP. turbine wheel which is direct-connected to a 1-4-HP., 25-volt dynamo, for charging the storage battery. The battery consists of eleven cells, and lights 20 8-c. p. lamps for 3 hrs. or 5 8-c. p. lamps for 6 hrs. Ordinarily, the windmill should run 5 hrs. per day to generate sufficient current for winter use, and 2 hrs. per day for summer use. Automatic hydraulic devices, however, enable the pump to store any amount of energy the windmill may produce.

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Tost of Materials. New materials, which it is proposed to use for paving, flooring and various building purposes, generally require the test of time under actual conditions before they are regarded with any confidence, and this fact has been the greatest possible hindrance to manufacturers and inventors advocating such materials. Various schemes and devices have been put forward by means of which certain substances may be tested to show their wearing qualities, but none of these has ever been truly satisfactory. Each has its advantages, of course, but all have disadvantages, and hence an invention universally applicable in the testing of almost all such substances is a matter worthy of comment. There are in use to-day many methods for conducting abrasion tests, which generally consist either in grinding specimens of material on cast iron discs with carborundum, or in treating the materials in revolving cylinders known as rattlers, either with or without steel balls. The grinding process is most unsatisfactory, as it gives a perfectly smooth surface to the material under test, and the cutting grains are themselves changed in form and characteristics, and thus their effect is materially modified. The grains also, when used with a soft specimen, become embedded, and hence a grinding takes place between the surfaces of such grains and the new grinding medium. The use of rattlers has a similar disadvantage, for particles of the material which are ground off have a very serious effect in reducing the action through clogging. It is to Germany that we owe thanks for the introduction of a new system of testing. The effect of a sand blast has been thoroughly appreciated for years, although no one seemed to consider the fact that if a sand blast were directed against a test piece, the peculiarities of the material would be fully shown. There is a machine now being used in the Royal Institute, at Lichterfelde, in which a sand blast is directed upwards against a test sample. This blast is operated by dry steam under a pressure of approximately thirty pounds to the square inch, and the sand used is a natural quartz sand of fine and nearly rounded grains. The standard test has been fixed upon as two minutes, and it has been estimated that a wear is produced in the test sample equivalent to at least one year. The test material is naturally held in a fixed position by means of clamps, and the surface which is subjected to the blast is protected by a cast iron disc, having a circular opening of fixed diameter. Thus, when the sample is removed from the machine, the depth of the abraded portion can be accurately measured, using the protected portions of the surface as a base. The beauty of this test is that an accurate comparison can be made between almost every class of material, as there is practically nothing which the sand will not cut. The surface of the test piece, after the operation is completed, presents an appearance in accord with the characteristics of the material; thus the disadvantage of the smooth surface obtained by the grinding process

is eliminated. Also with the sand blast there is no interference in the grinding medium, the abrading and abraded particles falling clear of the sample. If a soft spot exists in the material under test, this spot will be cut out, and thus accurate information can be obtained as to homogeneity, coarseness of grain, and uniformity, as well as equal or unequal hardness. The value of this system will be thoroughly appreciated, and it will probably be but a short time before such testing devices are in universal use.

Painting Machinery.

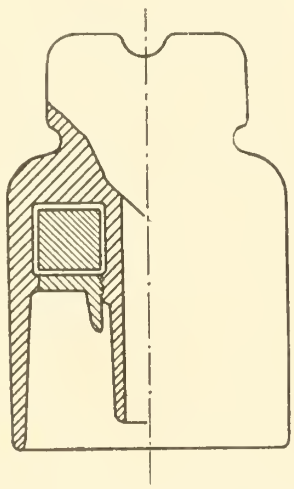
One of our American contemporaries recently published an article on the painting of machinery, advocating the use of light colored paints instead of the now generally adopted sombre hues, emphasizing the desirability of making such places as machine shops more attractive in appearance. Several instances are given where light colored paints have been used in power houses, the principal examples being New York hotels and theatres, comment being made that such places were frequently visited by tourists and other persons of an investigating turn of mind. There is no question whatsoever that the use of a light colored paint on the walls and ceilings of an engine room adds materially to its general appearance, and also increases to a marked extent the general illumination of such places, but painting machinery white is another matter, and one which we are inclined to think the general plant operator will have some objection to. The old time habit of painting machinery, walls, and ceiling, a dark color is much to be deplored, and is, in our opinion, as much out of reason as the exclusive use of a light paint. Machinery is machinery, and there are very few power houses which are intended to be places of entertainment. Use a white paint on your walls and ceilings and you will be well repaid, for this makes simple the illumination of every corner, and adds materially to the general cheerfulness of the place, but unless you wish to have a man constantly employed cleaning up, stick to the darker colors for the machinery itself.

Toronto Power Meeting.

A meeting was held in Association Hall, Toronto, on December twentieth, by the Mayor of the city, to which the Hydro-Electric Commission was invited. Mr. Beck made an able and most creditable address on the subject, though he failed signally in giving information which was of any value whatsoever, the questions which were asked being, with few exceptions, irrelevant. We have not attempted to contradict the figures which have been embodied in the report of the Commission, and for the sake of argument all such figures may be assumed as being correct. It should be distinctly understood that in making this assumption we do not admit their correctness, nor do we intimate at what points errors have been made. We are inclined to think, however, that the Commission has been too optimistic in figuring their operating costs. Perhaps the same thing can be said with regard to the first costs, and should these be found in error, the effect of such mistake will appear in the operating expenses. Our complaint is that the Commission has presented to the people figures covering the *cost of power at the twelve thousand volt bus bars* of the main step-down transformer station in Toronto. The original figure, which was in the neighborhood of sixteen dollars, was on a basis of fifty thousand horse-power, and we are even inclined to think that the city, in making application for fifteen thousand, has considerably over-estimated the demand. For fifteen thousand horse-power, however, a price in the neighborhood of eighteen dollars has been given by the Commission, and it is this figure which we are willing to admit as correct, on the basis before stated. We complain most strongly that this price, correct or not, *should never have been given to the public*, for we conscientiously believe that when the ratepayers of the City of Toronto supported the by-law on January first, they thought they were advocating a measure to supply them with delivered power at eighteen dollars per horse-power per annum. Mr. Beck was asked one vital question at the meeting last December, and that was with regard to the cost of distribution, and on the figures of his own engineers, he had to admit that the cost of such work was twenty dollars per horse-power, and not four dollars, as stated in the report. It is a matter of amusement to engineers conversant with the subject, that the Commission's first price for distributing was four dollars per horse-power. This they later modified to six dollars, an increase of fifty per cent. Evidently an error, and a very serious error, existed in the first estimates, and the question naturally arises, has a similar error been made in the estimated cost of power at the twelve thousand volt bus bars? If so, it means that the power will cost at this point twenty-seven dollars per horse-power per annum. Mr. Beck admitted the figure of twenty dollars and was at once sorry for it. He switched the discussion to another topic immediately, and it is doubtful if the audience appreciated what had taken place. If the right figure for power, delivered at the twelve thousand volt bus bars, is twenty-seven dollar, and the cost of distributing is twenty dollars, this gives a total of forty-seven dollars, and we believe that had the by-law been submitted to the people on such a basis, it would not have received support. As we understand it, however, the present by-law amounts to nothing—that is to say, it authorizes the Council to prepare a contract with the Commission, which contract must be submitted to the ratepayers prior to signing. If this be the case, and we most earnestly hope that it is, the people of Toronto will have an opportunity of considering the matter again before tying themselves up in such a serious way, and we do not doubt in the least that by that time the electors will know something about the proposition upon which they are called to express an opinion. What we cannot understand about the whole matter is this—*why has the Commission deceived the people, and why do they continue to deceive the people.*

INVENTION and DEVELOPMENT
IN THE ELECTRICAL FIELD

Combined Pupin Coil and Insulator. Pupin load coils are coming into use in Europe for telephone lines of considerable length, especially in Germany, where there appears to be the greatest progress in this direction. Such coils are placed upon the pole lines and are spaced the proper distance apart. But as some good means must be provided for protecting the coils against the weather, some of the constructors have been looking for the most practical method of carrying this out. A good solution seems to be that shown in the accompanying sketch. What is novel in this case is the combination of the porcelain insulator of the line with the coil itself, so as to contain the latter within the insulator. The drawing shows how this is carried out so as to lodge both the Pupin coil



COMBINED PUPIN COIL AND INSULATOR.

and the resistance for the lightning arrester, the latter being placed on the pole.

An insulator is used of the single-petticoat form, and is made with an annular chamber near the upper part. Coil and resistance are placed together and form a ring which fits into the chamber of the insulator, leaving a small clearance. Once in place a small cap working upon the core of the insulator closes up the chamber at the bottom. Melted insulating matter is then run in around the coil through a hole in the cap, so as to hold it solidly in place and prevent any moisture from reaching the coil through the joints of the cap. By this method of construction the main body of the insulator remains in a single piece, and it is as strong and as easily made as an ordinary insulator.

Magnet Coils for Arc Lamps.—Professor Elihu Thompson has patented a process for insulating coils which must withstand excessive moisture and high temperature. Each coil is composed of a single helix of ribbon copper, wound edgewise with the turns close together, so that it forms a tube of thickness of whose wall is the width of the ribbon conductor. After the coil is wound, and while there is some still space between the convolutions, it is covered by immersion with an insulating and cementing compound of kaolin and silicate of soda. The proportions of these two ingredients is such that the mixture is a viscous liquid, like a water varnish, which will soak into all crevices and form a thin layer between the metal coils. The entire coil is then closed together to form a rigid structure and is then subjected to a low red heat until the insulating compound is vitrified into an insoluble moisture-proof cement, which binds the coils together without permitting contact between its turns. This insulation is a double silicate of aluminum and sodium, and is refractory, being incapable of complete fusion except at a temperature which would melt the copper.

Experiments with Carbon, Osmium and Tantalum Lamps.—An experimental investigation has been made of tantalum and osmium lamps, with a view to comparing their performance with that of carbon lamps, by J. T. Morris. The Electrical Review, New York, from which we quote, says that the effect of voltage variation was first studied. It was shown that the carbon filament is most affected in this way. One per cent rise in voltage with the carbon lamps causes a change in candle power of sixty-seven per cent. With the osmium the same voltage change means a four and one-half per cent change in candle power. In carbon lamps the candle power varies as the cube of watts, while with the tantalum lamps it varies as the two and one-half power. The effect of temperature on the resistance of the filaments is entirely different. In carbon the resistance is greatest when cold, while in the metallic filament the resistance is lowest when cold. It is shown that for a system supplying 100 amperes the tantalum lamps might, if suddenly thrown on, draw 630 amperes from the generator. Osmium lamps would produce a still greater instantaneous load, the current being 790 amperes the instant of closing the circuit. Comparing the instantaneous variations of candle power when the lamps are supplied with alternating current showed that the variation for 220-volt carbon lamps is greater than that for the tantalum lamps; while, on the other hand, the variation of a 110-volt carbon lamp is less than that of the tantalum lamp of the same voltage. Candle power measurements show that the tantalum lamp gave 138.8 horizontal candle power per square inch of filament surface, or 105 mean spherical candle power, with a watt consumption of 1.6 per horizontal candle. Robertson has stated that a carbon lamp lasts longer on alternating current than on direct for the same voltage, an effect which has hitherto been ascribed to the same cause as that noticed by Kelvin on direct current, that the lamp lasts longer if the polarity is often changed. Assuming candle power to be a sine wave of amplitude, as was obtained by experiments, the life on alternating current should be considerably greater than on direct. Arguing from analogy, it would seem that the tantalum lamps should have a

correspondingly increased life; but experience has shown otherwise. The reason is not clear. However, careful observation shows that when a tantalum lamp is first turned on it emits a slight noise, which is caused by the filament moving over the wire supports as it expands. It is thought that the alternate stresses upon the filament as it alternately heats and cools when carrying alternating currents may be the cause of the apparent crystallization which goes on, and it is possible that by using a more flexible support or by winding the filament itself in a small spiral that the effect might be diminished.—Abstracted from the Electrician (London).

60,000-Volt Direct Current Transmission.—An interesting 60,000-volt direct current transmission system is in operation from Moutier to Lyons, France, a distance of over 110 miles. This is the longest transmission ever attempted with direct current, and it is particularly striking from the fact that the direct current system is united to a three-phase system coming into Lyons from other points with provisions for the mutual interchange of energy. The power provided for is 4,500 k.w., delivered at a maximum full load pressure of 60,000 volts. To generate this high voltage no less than 16 constant-current dynamos are connected in series, each with capacity for the full 75 amperes and capable of working up to 3,900 volts. Dynamically there are four groups, each of four generators, but each group is split into two pairs by an insulating coupling and each consisting of two generators on a common feed plate. A similar insulated coupling unites each water wheel to its group of generators. The provisions for regulation are simple. One motor regulator at Moutiers holds constant-current conditions for the whole station. Each wheel whe started up is hand-regulated until it takes its share of the load and the governor thereafter regulates all the wheels together.

Speed Recorder for Dynamos and Motors.—A new form of recording device has been brought out in France for recording the performance of a dynamo or motor during each revolution by means of a series of sparks perforated in a moving band of paper. When running alternators in parallel, it is often difficult to determine whether the irregularities are due to the engine or lie in the dynamos themselves. The present instrument is intended for such cases. The base of the device consists of a registering tachygraph, this being composed of a swinging arm, working by a centrifugal device on the shaft to be tested and thus giving a swing in accordance with the speed of the shaft, together with a fixed plate or support. Under the pen of the arm, a band of paper moves from left to right, drawn by a clockwork drum. A series of curves drawn by the pen thus show the speed variations of the shaft under test. Here the apparatus is connected with the shaft by a set of gearing instead of by belt, so as to avoid the damping effect which would be caused by the inertia of the pulley.

New Gas Turbine.—An experimental gas turbine has recently been constructed in France which under test showed an efficiency of 18 per cent. The turbine is of the impulse type, with the casing lined with refractory material. Gasoline is used as fuel and is fed under pressure through an expanding nozzle, being ignited electrically and generating a temperature of combustion of over 3,000° Fahr. The blades were cooled to a certain extent, while rotating by low-pressure steam admitted into the casting.

Transmission at 120,000 Volts.—Mention has recently been made of a projeet for the supply of electric energy to Paris from a point on the Rhone, more than 250 miles distant. It is proposed to use the constant direct-current system, with a voltage of 120,000 volts at full load. No less than 48 generators are to be installed in series, each giving 1,000 amperes at a maximum of 2,500 volts.

PECULIAR COTTON-MILL FIRE IN MONTREAL.

In a report on a recent fire in the Dominion Cotton Mills at Montreal, the insurance inspector finds conditions which are of interest. The mill in which the fire occurred is supplied with motor-driven machinery, the main current supply being 2,000-volt, 60-cycle, two-phase, from the Montreal Light, Heat and Power Company.

On the afternoon of the fire, the high tension current was suddenly cut off at the power company's sub-station, and the motors in the mill at once slowed down. For some unknown reason the current was again thrown on to this circuit at the sub-station without notifying the mill electrician, as should have been done. The result was that two, possibly more, coils of the synchronous motor were immediately burned out. The electrician noticed that something was wrong, and went immediately to the high tension switchboard and pulled the main switch on one of the power panels. A short circuit took place across the switch, and the heat was so intense that the electrician was forced to run from the room. It is not definitely known whether the arc itself spread from one panel to the next or whether the burning of the insulation from the wires on the back of the panels in turn caused short-circuits at the other panels. However, almost immediately the entire switchboard room was filled with flames and the insulation on the wires on the outdoor circuits leading to the tower was soon on fire, showing that there were very heavy short circuits on the switchboard. It was estimated by the electrician that the arcing continued on the switchboard for about ten minutes. The fire was extinguished after about half an hour, but not before considerable damage was done.

The inspector points out the following lessons to be drawn from this fire:

Rooms containing switchboards or other apparatus forming centers of large electrical power should not be used for storage of supplies.

Some ready and safe means should be provided for controlling the high-tension current outside of the property.

While there is nothing new in these conclusions it is probable that there are other plants in which they have not been observed, and a disaster like the one here related should hold a lesson for them.

ELECTRIC TRACTION FOR MODERN HIGH TENSION VEHICLES.*

By Carl Wegman.

Up to the present two different systems of electric traction have been successfully applied to standard railways of considerable length: the direct current third rail system and the three phase current with two wires overhead it has been argued in favor of electric traction that the heavy trains may be subdivided into small trains or even into single car units. Now while there are certain sections in an extended railway system where a number of smaller trains would perhaps suit the public better than fewer but longer trains, provisions must be made to handle freight trains and solid or mixed passenger trains from adjacent railways in a way that will not interfere with the latter's organization of traffic and traction even though they are operated electrically. The opinion is that a system to meet the requirements and views prevailing in present railway practice must not ask the railway management to restrict themselves or change their system of making up trains and arranging time tables.

It seems even necessary to accept the present organization of the traffic as a basis for the development of a system of electric traction to supersede steam traction and to supersede it gradually and to work simultaneously with steam either on the same lines or on different lines exchanging traffic.

The present method of handling the traffic on standard railways once accepted, the electrician is confronted with the problem of moving the trains now hauled by steam locomotives. This will cause him to abandon as the principal feature of his plan the small motor car units and to provide for an electric locomotive which will take the trains as they are actually to-day to handle them in the same way as the steam locomotive.

The high tension forbids the application of three phase currents because this system requires two contact wires installed from each other, only a single trolley promises to be reliable in operation.

The voltage being necessarily high, direct current seems to be excluded from the transmission line and one is forced to come down to the single phase alternating current of high pressure. This current, however, is not applicable to the working of the motor driving the axles of the vehicle. We have already come to the conclusion that locomotives will have to be accepted, because of the demand of the traffic organization; we shall, therefore, have to provide for the sufficient adhesion of the locomotive. This requirement is important as it will permit us to put machinery on the locomotive to convert the high pressure current for driving the axles. This conversion of current single phase alternating into direct current, using direct on the locomotive may be performed by a motor generator, or by a rotary converter with transformation of the voltage. We could adopt the series parallel system of control for the direct current motors on the axles. It has been found, however, the conditions are favorable to use a system of adjusting the turning moment of the driving motors by adjusting the voltage of the direct current generators on the locomotive using separate excitation. If this method is developed further a most satisfactory arrangement is obtained with regard to economy, graduation and safety of speed, of starting, breaking and returning energy to the contact line. This system here outlined with the exception of the high tension brought into the vehicle seems to be most satisfactory, and from this basis the leading firms are working out their details. The Oerlikon Company in Switzerland, the leading firm in Europe, has worked out this problem to a good resolution and the Swiss government has already accepted this system for their standard state railway. And in this country we will find typical representatives of this system

Besides a great number of special arrangements which give the system its full value for the purpose aimed at special design and construction of the several parts of the equipment of the locomotive, especially of the converter, has been necessary. The details of the current collector and the contact line, together with safety devices, largely contribute toward facilitating the useful application of the general principle and especially of its safe operation under high voltage, without which the rotary converter does not exert half its usefulness in electric traction on railways. The employment of a rotary converter only becomes of value when used in connection with high tension circuits. The fact that a transformer plant had to be installed on the moving car led people to abandon the idea because too much stress was laid on the difficulties presented and too little on the advantages to be achieved and because the use of the single phase A.C. was lost sight of by the engineers, who had become accustomed to the direct current and three phase current for traction purposes.

By using single phase current for transmission and rotary converters placed on the locomotive to convert the alternating current into direct current, all of the advantages of the three phase regulation can be retained without any of its disadvantages.

Assuming a locomotive was designed for a line voltage of 15,000. The weight of the train to be 250 tons, speed twenty-four miles, and a grade of 10 per cent., then we will have 575 horse power at the track. Assuming the transformer locomotive to have a useful efficiency of 75 per cent., then we must take from the line 575 times 746 divided by .75 equals 570 kilowatts, or assuming a shifting of the phases of 10 per cent. and a pressure of 14,000 volts at the point of consumption, 570,000 divided by 0.9x14,000 equals 45 amperes. The chosen output is not a maximum, but is above the average. We see that the currents even for heavy trains are not above those to which we are accustomed for street railways and small railroads, and that the current may easily be collected and the construction may be lighter and the speed greater. This facilitates the construction of a suitable trolley line for ordinary roads. Let us take the case in which there are two heavy trains in motion twenty-four miles apart on the same side of the feeding point. These two trains take from the line a total of 90 amperes. Assuming the two wires each to be 0 B and S guage, then we have a loss of energy over the twenty-four miles of 600 volts times 90 amperes, equals 54 kilowatts, or about 4 1-2 per cent. of the energy supplied to the feeding point and about 4.1 per cent. of the pressure at the feeding point. Two such wires have a weight of about 680 pounds per mile. We will assume the use of the rails for returning the current. We now have to deal with the one serious disadvantage of the alternating current, namely, the inductive effect in the rails which shows itself in the increase of the apparent resistance and the actual loss of pressure. This effect increases with the numbers of periods of the alternating current. At 42 cycles the apparent resistance is eight times that of the ohmic resistance. This results in losses in pressure on these long distances even with small current densities such as are used with high pressures, and to eliminate these losses is very desirable in many respects. For this reason a small number of periods must be chosen, although this implies increase of weight and cost of the single phase alternating current generators, motors, and transformers. According to experiments with periods up to 60 cycles, when the periods are 16 the rail resistance is increased three times, and if this is reduced to a copper wire having the same cross section we have 3 times 9 or 27 fold. On a track weighing 140 pounds per yard, this loss of voltage for a twenty-five mile rate about equals 180 volts, and neglecting the shifting of the phases in the rails 1.64 watts equals 1 ¼ per cent. In general there are more than two trains on one side of the feeding point on a twenty-four-mile section, but

*Abstract of a paper read before the Waterdown Society of Engineers, Waterdown, N. Y. Mr. Wegman is well known in Canada, having been connected with the electrical firms in Toronto, Montreal and Peterboro.

we believe that to assume three such trains at twelve, twenty-four, and thirty-six miles, is a very unfavorable load, then the loss will be about 6 per cent. One might be tempted to choose a lower pressure, but it is not believed that a much lower pressure is sufficient, while the choice of a much higher pressure is not desirable or necessary. Small current and track losses seem to be the determining factors, together with the safety of the line and insulation of the machinery. It is believed that 15,000 volts is the highest pressure that can be generated directly by machines without much difficulty, and conveniently transformed on the locomotive, and for which mechanically perfect insulators can be obtained. The problem is, therefore, to construct a trolley line and current collector which will permit the use of 15,000 volts. The high tension wires are suspended from wires stretched between two sets of poles located at each side of the tracks, and these suspending wires are attached to high tension insulators. If the contact roller is used it can be easily insulated from the car. In general, the single pole construction is a very simple one and so far as safety is concerned, is far superior to the customary over-head circuit.

Trolley wires have certain disadvantages which are more apparent in the case of high pressure systems than when working on low pressure. It can not be denied that the trolley wire is the most easily damaged portion of an electric railway system, and it would seem unwise to hang the fate of electric traction for trunk lines on a single wire. Nevertheless there is a construction on the market which answers also this question. The wire is located to one side of the road instead of over the tracks and is supported on ordinary trolley wire supporters from beneath or at the side instead of from the top. These supporters are fastened to high tension insulators. The current is conducted by means of a conducting rod which is movable about an axis in a plane perpendicular to the direction of the motion of the car and can be moved around an entire semi-circle. This trolley is constructed in the form of a convex rod which solves the problem of air switches and crossings. It permits passing over a lateral high tension line to a central low tension line at large stations.

The current is returned through the rails which are connected by efficient rail bonds.

Many methods are in use for obviating the disturbances in low pressure lines within the neighborhood of the trolley line. The large differences of potential existing on long lines are eliminated very largely by boosters. While the system under discussion conflicts with many street railway regulations regarding the overhead construction, none of the differences would furnish a reasonable objection to the construction of an economical and simple system.

In regard to the converter locomotive it may be stated that its essential feature is the generating of direct current for the propulsion of the car motors and the utilization of single phase A.C.

By a peculiar method of compounding the motors and generators and connecting all parts which affect the field, strength, etc., a method has been devised to regulate speed economically and automatically and to employ the starting and braking. The economical production of large tractive power at small speeds is a problem which is not solved by all systems having a constant electromotive force. At motor terminals on such systems, we find the objectionable peaks in the load diagram, which are responsible for the large power consumption and the installation of larger units.

The direct current circuits are not connected to earth, thus insuring greater protection to the insulation than is usually the case on street car motors.

All motors on the train, including those on the locomotive, can be simultaneously regulated. This makes it possible to increase the weight on the driving axles. This method will be welcomed on roads with heavy grades and defective rails.

It may be of interest to note that the converter locomotives weigh considerably more than vehicles without transformers. A locomotive which can exert a drawbar pull up to 11,000 lbs. at a speed of from 21 to 24 miles, weighs approximately as follows :—

Locomotive, dead weight	33,000 lbs.
Converter and exciter	35,200 "
Regulators, circuits and collector	2,200 "
Braking device	24,200 "
Total	94,600 lbs.

Comparing with this system on which the three phase current is used, under similar conditions of speed, efficiency, grades, pressure, etc., it will be found that the result is about the same for both systems. The converter locomotive of 44 tons could be replaced by one or two three-phase cars weighing 30 tons. If we assume the locomotive to have an efficiency of 75 per cent., a working factor of 0.9, a total train weight of 250 tons, a grade of 10 per cent., a speed of 24 miles and a pressure of 14,000 volts, then the locomotive requires 45 amp., while the three phase motors and transformers having an efficiency of 80 per cent., a working factor of 0.9, and a weight of 236 tons, require a current of 23 amps., each of which have to flow through two wires insulated from each other. Using the same amount of copper, therefore, the loss in the conductors is about the same for three phase motor as for the converter locomotive—namely, 2x23, or 46 amp. There is, however, a saving of energy on the locomotive at starting which enables the raising of the working factor by using a synchronous motor for a converter. This necessitates shifting the phase only about 5 per cent.

While actual figures do not prove a decided difference, other considerations must prove the superiority of the single phase A.C. converter locomotive.

If three phase currents of less than 15,000 volts could be led directly to the vehicle, the small gain in total efficiency would be largely overbalanced by the single phase installation in the case of the converter locomotive, the greater ease of speed regulation and the possibility of furnishing energy to the line within wide limits and not for high speeds alone. In addition to this, the locomotive offers the following advantages over the three phase motor cars :

The direct and indirect danger to passengers from the line is practically eliminated. The locomotive may be constructed entirely of non-burning material. It is possible to run in addition to the locomotive a number of self-propelled cars for suburban or local traffic, or to attach a number of cars to the locomotive, or, finally, to operate branch lines having light traffic with direct current furnished by converter locomotives stationed at convenient points along the A.C. main line.

The chief points of this system are high tension and small currents, the laterally arranged and supported "not suspended" trolley line, the collector having a wide range of contacts and the low tension branch circuits for large depots.

Furthermore, the electric locomotive takes the place of the ordinary steam locomotive and the necessary weight is obtained by the installation of the converter equipment.

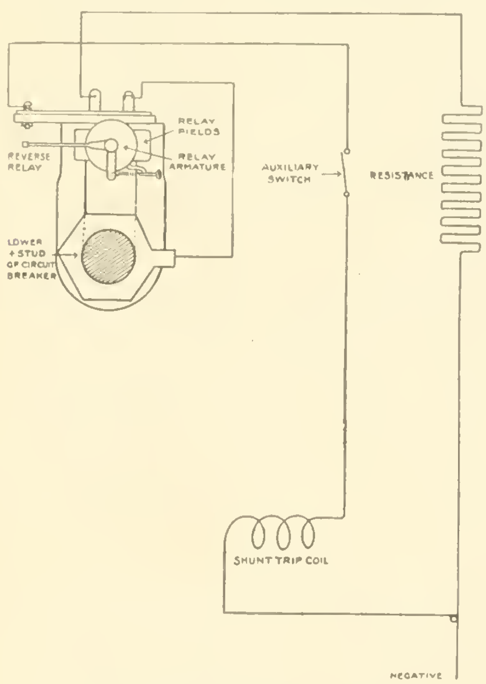
In order to enable a gas engine to work either with suction producer gas or from the city mains, an English inventor proposes to insert between the engine and the delivery nozzle of the producer plant a sort of gasolene carbureter consisting of a vessel packed with an absorbent material which is saturated with gasolene or some other suitable hydrocarbon. The idea is that this carbureter will enrich the producer gas so that its calorific value will about equal that of the gas in the city mains, and the engine, therefore, will operate equally well when supplied from the producer or the mains. This is ingenious, but it would increase the cost of the gas supply from the local plant. On the other hand, the engine would be considerably smaller than one to give the same power with producer gas alone.

Electric Railway Department

A REVERSE CURRENT RELAY.

By Frank H. Wisner.

The Cleveland Electric Railway Company formerly experienced some trouble due to switchboard men throwing generators on the line at low voltage, causing the burning out of generator armatures and occasionally knocking out the entire station. This trouble has been entirely overcome by the use of a reverse current relay which in the event of a machine being thrown on the line before it has come up to full voltage will trip the individual machine circuit breakers on the main station board, thereby protecting the machine from the consequent reverse current and keeping the other circuit breakers on the board from operating. Since these reverse current relays have been in use there has been absolutely no trouble from this cause, although the switchboard men have on occasions attempted to throw in generators at low voltage, but the only effect has been to throw the generator off the line and slow down the engine.



Reverse Current Relay.

The reverse current relay includes a small steel horseshoe, the ends of which are wound to serve as the fields for a small armature. The steel field is placed on the lower stud of the machine circuit breaker, and is held in place by the stud nut. The small armature of the relay is connected to the positive buss through resistance to negative buss, and the armature is therefore always in series with the generator, the current flowing normally through the armature from positive to negative buss. In connection with this relay there is a shunt trip coil placed on the front of the switchboard. The plunger of this trip coil (the coil being an ordinary solenoid) is attached to the trip of the machine circuit breaker so that when the coil is excited the circuit breaker will open. Attached to the armature of the relay is a small arm. When the current is flowing in the normal direction the armature is held in position so that this small arm is kept away from a contact pin, but the instant the current reverses, as when a machine is thrown on at low voltage, the armature is thrown over in the opposite direction, a stop catching it after it has made a quarter turn, thereby throwing the small arm attached to the armature over against the contact pin. The result of this action is to close an auxiliary circuit through the solenoid tripping device on the front of the board, thereby actuating the solenoid and tripping the breaker. To protect the board attendants from receiving a shock while they are cleaning down the board and wiping off the breakers there is an auxiliary plunger switch in the relay circuit and this switch opens when the machine circuit breaker opens.

On the switchboard there is a positive buss only, and this positive is of course connected to the generators through the breaker in the ordinary way, the machine panel switch being of the single pole brush toggle type. At each generator is a negative panel carrying an automatic circuit breaker, a single pole brush toggle switch connected to the negative buss, and a quick break single pole switch used on the equalizer (the equalizer being on the negative side).

These machine panels are in some cases 100 ft. from the positive panels on the main switchboard. Each of the ciruit breakers on these negative panels has a shunt trip coil connected to the reverse current relay on the positive generator panels so when the reverse relay operates it trips both the positive and the negative circuit breaker of the generator.

The negative station buss is in conduits under the sidewalk outside the power house.

There is a power house order that all reverse current relays must be tried once every week. If they are found O.K. an entry is made to that effect on the station log. If found out of order, note is made of the fact in the log and immediate steps are taken to remedy the trouble. By this test system if a relay does not work in time of trouble the responsibility can be placed at once upon the attendant who is at fault.

By experiments made on a 2400-k. w. generator it has been found that the relay reverses at approximately 200 amp. of current. It will of course be understood that the current in the armature of the relay always flows in the same direction. That is, the current never reverses in the armature, but when the voltage drops the current reverses in the field of the relay, thereby throwing the armature in the opposite direction.

In connection with the reverse relay described, a similar relay is also used to trip the circuit breakers on the feeder panels in connection with a plug relay board. For instance, if there are 20 feeder circuits and four generators, by means of the plug relay board five circuits would be carried through each generator circuit breaker. If one of the machine breakers goes out the feeder relay automatically trips those five feeders and does not overload the remaining three generators

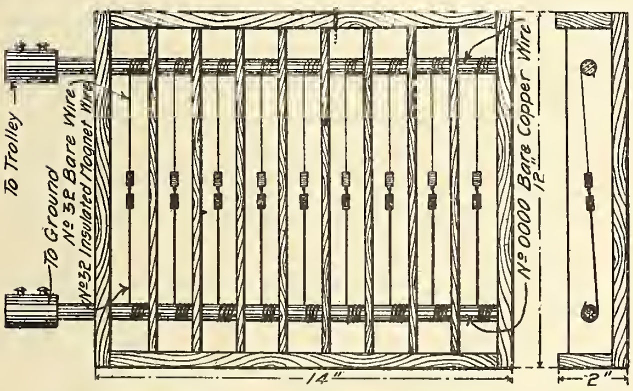
in use. Each feeder relay consists of a plug panel, a butterfly switch and trip coil.

The switchboard attendant does not figure in any of the aforementioned performances as they are all automatic, although the attendant can trip any breaker by hand if he wishes to do so.—Electric Traction Weekly.

A SIMPLE LIGHTNING ARRESTER FOR USE ON CARS.

A home-made lightning arrester, simple in design and inexpensive, the general arrangement of which is shown in the accompanying illustration, has for the past two years been used with satisfactory results on the cars of the Toledo & Indiana Railway Company. Although the territory through which this company's lines operate is at times subject to heavy electrical storms, no arrester troubles due to lightning have been experienced on the cars equipped with these arresters.

The essential parts of the arrester are enclosed in a box 2x12x14 inches in size. The interior of this box is divided by partitions into nine compartments of equal size. The two opposite poles of the arrester, one of which is conected with the trolley and the other with the ground, are straight pieces of No. 0000 copper wire which pass through the partitions, at opposite sides of the box. In each of the nine compartments is a so-called fuse, consisting of two pieces



Simple Lightning Arrester Used on Toledo and Indiana Cars.

of No. 32 copper wire. One of these pieces of wire is insulated and the other is bare. One end of the bare wire is wrapped about the No. 0000 bare copper positive pole and the other end is joined with one end of the insulated wire by an ordinary "Western Union" joint, but the insulation is not removed before making the splice. The opposite end of the insulated wire is wound around the negative pole of the arrester without having its insulation disturbed. By this arrangement of wire and the insulated-noninsulated joints, of which there are nine in the arrester, a sufficient resistance is afforded to withstand a normal pressure of 1,800 volts, but should the set of fuses be subjected to a higher voltage or to lightning the increased potential will puncture the insulation and allow the excessive charge to pass to the ground. These boxes are installed in a vertical position with positive conductor above and are inspected several times each day.—Electric Railway Review.

A company of Winnipeg capitalists is seek incorporation under the name of the Suburban Electric Railway Company, to build probably 800 miles of suburban electric railway. It is said that the project will be backed by a capital of $5,000,000.

NEW SUPERINTENDENT MONTREAL STREET RAILWAY.

Mr. A. Gaboury has been appointed superintendent of the Montreal Street Railway, as successor to the late Mr. L. Trudeau. Mr. Gaboury has been practically in charge of the department since last May owing to the serious illness of the late superintendent.

Mr. Gaboury in the short space of twelve years has risen from the lowest wrung of the ladder to be superintendent of the whole system of the Montreal Street

Mr. A. Gaboury,
Superintendent Montreal Street Railway.

Railway. It was in 1894 that he joined the service as conductor, in which position he worked for some seven years. In 1901 he was appointed assistant inspector, which was the occasion of the visit of the Duke of York to Montreal. In the same year he was placed in charge of the Cote street sheds and later was named chief clerk of the St. Denis street shops. On the return of Manager McDonald from Paris, in 1903, Mr. Gaboury was appointed claims agent. The kind of supervision required for this department gave Mr. Gaboury good experience for his next step, and when last May the late superintendent had to retire, Mr. Gaboury was appointed assistant.

QUALIFICATIONS OF STREET CAR DRIVERS.

In an act passed to incorporate the Charlottetown Electric Transit and Power Company, Limited, which was granted power to operate a system of electric cars in the city of Charlottetown, a clause was inserted requiring that all drivers of cars should be of the full age of 21 years and should obtain the written permission of the mayor of the city before acting as such. A conductor or motorman is also required to wear a badge bearing his number on a conspicuous portion of his dress. The company, when required, must furnish a list of its conductors and motormen and the name of any one of them driving or conducting a car at any specified time. A conductor or motorman violating the above provisions is subject, where no other remedy is provided, to a penalty not exceeding $20, with the alternative of imprisonment for 20 days.

BREAKDOWNS OF ELECTRICAL MACHINERY

We have again been favored with a copy of the annual report of Mr. Michael Longridge, M.A., Chief Engineer of the British Engine, Boiler and Electrical Insurance Company, of Manchester, England. The business of this company is the insurance of engines, boilers, dynamos and motors against damage from breakdowns, explosion or collapse.

Referring to the insurance and inspection of electrical machinery, the report states that the increase in the number of breakdowns was much greater than in the previous year, being 32.8 per cent. The Chief Engineer is of the opinion that this increase is due in part to deterioration of electrical machinery by age and use, but at the same time he thinks that the heavier fuses which the company has been compelled to allow to meet the heavy starting currents required by motors in so many cases are not without influence on the rate of breakdown. This rate among dynamos is decreasing, but among motors, particularly small motors, it is increasing, and somewhat rapidly increasing. In 1905 it was no less than 1 in 8, which means that every eighth motor insured broke down within the year. Among dynamos it was lower. The rate among continuous-current motors exceeded the rate among alternating-current motors by 40 per cent., while the rate among alternating-current dynamos exceeded the rate among continuous-current dynamos by 29 per cent.

The proportions in which the various parts of the machines are thought to have given way are set out in the following tables:

	Dynamos.	Motors.
Armatures and rotors	53 per cent.	48 per cent.
Magnet coils and stators	6 "	13 "
Commutators and brush gear	25 "	28 "
Miscellaneous	16 "	11 "
	100	100

Starting Switches and Controllers.

Resistance coils	48 per cent.
Contacts or switch arms	15 "
Automatic apparatus	13 "
Miscellaneous	24 "
	100

The causes of the breakdowns were probably the following :—

	Dynamos.	Motors.
Accident	15 per cent.	9 per cent.
Dirt and neglect	14 "	19 "
Age and deterioration	21 "	25 "
Bad workmanship and design	23 "	18 "
Overloading	0 "	2 "
Unascertained	27 "	27 "
	100	100

Starting Switches and Controllers.

Accident	22 per cent.
Dirt and neglect	11 "
Age and deterioration	23 "
Bad workmanship and design	9 "
Improper Use	7 "
Unascertained	28 "
	100

Examples of each class are given below, and in selecting them an endeavor has been made to choose, as far as possible, cases which are representative of large numbers of like cases, so that the experience of the company may be available for any who may be trying to discover and amend the weak points in electrical design and practice.

1.—Continuous current compound wound 2 pole dynamo, giving 30 amperes at 250 volts when running at 1,030 revolutions per minute.

Several of the armature conductors were burnt. When the armature was taken out the lid of a vaseline tin was found between it and the magnets. This had cut the insulation and short-circuited the conductors.

2.—Continuous-current compound-wound dynamo, giving 144 amperes at 100 volts when running at 840 revolutious per minute.

The description of the accident given to the inspector by the attendant was as follows : "Suddenly, when this dynamo was running, I saw a ring of flame inside the pole pieces. I at once stopped the dynamo, and found that something must have got in between the pole pieces and the armature. I could find nothing at all when I took the armature out, and apparently the thing, whatever it was, had just made one revolution and then flown out again."

What the thing was was not discovered, but the evidence of its presence was clear enough in the shape of a slight groove all round the armature about 2 in. from the pulley end, which had more or less short-circuited the conductors.

Accidents of this kind are not uncommon. That the magnets of dynamos or motors when excited attract steel or iron like any other magnets is no doubt well known, but the knowledge often seems to be forgotten, and oil cans, spanners, nuts, and other bits of iron are left in positions where it is possible for the field to catch them and suck them in.

3.—Continuous-current 4-pole series-wound enclosed motor, running at a speed of 600 revolutions per minute with current at 220 volts.

The motor drove the live rollers in connection with the hot saw in a rail mill. It was stove in by a rail which for some unknown reason jumped off the rollers when being carried to the saw.

4.—Continuous-current shunt-wound motor, taking 20 amperes at 230 volts for driving a passenger hoist. The motor was controlled, as shown in fig. 1 and 2, by a double-break switch S S actuated by a horizontal

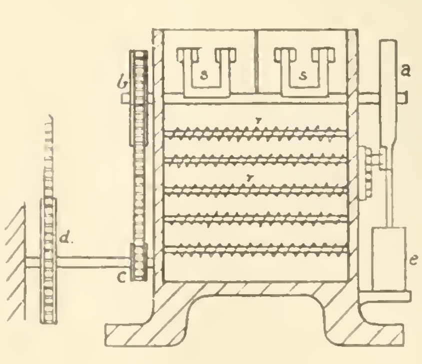


Fig. 1.

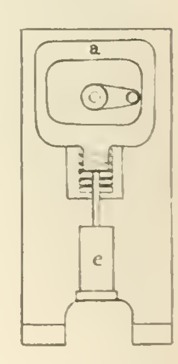


Fig. 2.

shaft *a b* carrying a sprocket wheel *b*, which was driven by a chain from another sprocket wheel *c* on a countershaft *c d*, which in its turn was moved by a third sprocket wheel *d* and a chain attached to the lower end of the hand rope running through the cage. By pulling the hand rope in one direction the attendant closed the switches, and at the same time liberated the plunger of a dashpot which, in descending, cut out the

coils *r r* of the starting resistance automatically. By pulling in the other direction he opened the switches, stopped the motor, raised the plunger in the dashpot, and threw the starting resistance into circuit.

The dashpot, as the diagram indicates, consisted of two concentric cylinders, one within the other, with an annular space between. Through the wall of the internal cylinder several 3/16 in. holes were bored through which the oil escaped as the plunger descended by its own weight.

On the occasion of the break-down the cage was at the top of the well. The attendant pulled the rope to close the starting switch, and the cage began to descend, but at a slower speed than usual. It is uncertain what happened next, but probably he tried to accelerate the descent by a violent pull at the hand rope. At all events, he pulled it hard enough to twist the countershaft *c d*, and break the chain and sprocket wheel on the shaft which moved the switches, leaving the latter closed.

The motor therefore went on running, the cage went to the bottom of the well, and balance weights were wound up till they jammed at the top, when the fuse melted. After examining the broken parts without finding anything to account for the accident the Inspector, noticing that more than half the resistance in the starter was still in circuit, was led to investigate the inside of the dashpot. In it he found the cause of the mishap, a small piece of silver or German silver watch chain, ⅜ in. long by ⅛ in. diameter, sticking through one of the 3/16 in. holes sufficiently far to jam the plunger of the dashpot near the top of its stroke. How the piece could have got into such a position is a mystery.

The breakdown shows the need for limit switches at the top and bottom of hoist wells to cut-off the current automatically in the event of accident to the controlling gear.

5.—Shunt-wound motor, 12 H.P., running at 1,200 revolutions per minute with continuous current at 220 volts.

The motor drove a punching machine. Fig. 3 shows its connection to the distribution board.

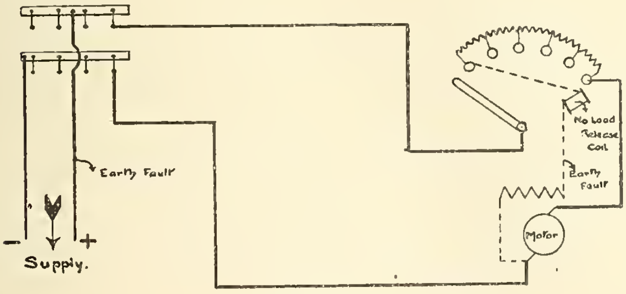


Fig. 3.

When the installation was inspected in April the Inspector found the positive-supply cable "earthed" and the fault was duly reported to the owners, who were advised to rectify it. Evidently no notice was taken of the advice, for about a month afterwards the "no-load release" coil on the starting switch, and several of the resistance coils in connection with the same, were "burnt out" by a man driving a nail through the casing containing the shunt lead between the motor and the starting switch. The nail came into contact with the wire and with the frame of the machine to which the casing was attached. This established a circuit from the earthed positive supply cable, through the machine, the nail, the no-load release coil, the resistance coil, and the motor armature to the negative. The diagram shows that the "burn-out" could only happen when the motor was standing.

6.—Series-wound motor, 54 amperes, 340 volts, driving a coal cutter. Owing to accumulation of oil and dust on the insulating ring at the outer end of the commutator one of the segments got into electrical contact with the frame. As the result did not interfere with the use of the machine, and as the coal face was too dry to allow the pitman to receive shocks of any severity, no attempt was made to restore the insulation at the faulty part. Soon after a second fault occured through the same cause on another of the segments, short circuiting a portion of the armature and burning the conductors. The armature, owing to its construction, had to be entirely rewound.

Had the frame of the machine been earthed effectively the development of the first fault would have been indicated by the earth lamp or other instrument on the dynamo switchboard, and on putting one of the mains to earth, the fuse at the motor would have melted, the fault would have been located, and it could then have been remedied. Thus the burning of the armature which followed the development of the second fault would have been saved, and the risk of shock to anyone touching metal in connection with the motor would have been removed.

One of the special rules for the installation and use of electricity in mines provides that "all metallic coverings, armouring of cables, *other then trailing cables* and the frames of generators, transformers, and motors, *other than portable motors*, shall, as far as is reasonably possible, be efficiently earthed where the pressure at the terminals where the electricity is used exceeds the limit of low pressure," which is 250 volts. The italics are the writer's. The words exclude the motors of coal cutters and their trailing cables.

It is, of course, difficult to get a reliable earth near the coal face in a dry mine. Armoured cables cannot always be depended on, as the continuity of the armour is often broken by rough usage or at junction boxes.

It would almost seem as if the only satisfactory plan would be to carry a third wire from bank or from some other place where a reliable "earth" could be obtained to the distribution board supplying the coal cutter, and to incorporate a third wire with the trailing cable which would automatically connect the earthed wire at the distribution board to the motor frame. This sytem might be applied to other portable motors such as those attached to movable pumps and drills.

7.—Continuous current 48 kw. motor transformer, with double-wound armature, receiving current at 1,000 volts, and generating at 115 volts; one of several placed in different sub-stations to feed a low tension network.

In ordinary working the field magnets were excited by current shunted from the low-tension brush leads, but for starting purposes there were also a fairly large number of coils in series with the tension circuit, which were automatically cut out by a "stray-field" switch, when the excitation was complete. There was also an automatic single-pole switch on the low tension side for connecting to and disconnecting from the low-tension cables.

The high-tension cables were protected by double pole fuses at the generating station. One day these fuses melted, indicating some fault in the system, which was afterwards found to be a short circuit on the mains supplying the transformer.

A man was at once sent to the sub-station. He found the transformer running at an excessive speed and stopped it, but not before the binding wires had been broken and the end connection to the armature spread by the centrifugal force, so that the armature had to be entirely rewound.

There was some uncertainty as to the cause of the mishap, but after getting all the information obtainable the Company came to the conclusion that when the high-tension current was cut of by the melting off the fuses and the machine began to run as a motor with current from the other transformers, in connection with the low-tension network, and to deliver current to the short circuit created by the fault, the current taken from the low-tension mains would be so great as to cause a heavy momentary fall of potential in these mains, and in the shunt, which would demagnetize the field sufficiently to throw out the "stray-field" switch and throw in the series windings.

These opposing the effect of the current in the shunt wolud permanently weaken the field and allow the armature to attain a speed sufficient to cause the damage above described.

This conclusion was supported by a very important fact not hitherto mentioned. The automatic switch on the the low-tension side was out of order and failed to fall out at the moment the current was reversed. Had it acted as was intended, the machine would have been switched off the low-tension mains when the fuses on the high-tension cables melted.

8.--Continuous-current compound-wound 2-pole dynamo, with Siemens drum armature, giving 364 amperes at 110 volts.

When the dynamo was stopped for the dinner-hour one day smoke was seen rising from the commutator end of the armature accompanied by a smell of burning. No notice seems to have been taken till, on trying to start after dinner, the field magnets refused to be excited. The Inspector was then sent for. He removed the bands and coverings, and found the spaces behind the commutator spokes filled with black dust from the foundry in which the dynamo was working. He removed the dust as far as possible, and tried to start, but was still unable to obtain a field. A close examination showed that the dust had so permeated the cotton covering of the conductors as to destroy its insulating property and short-circuit the armature windings. After insulating these by pushing pieces of mica between them at the worst places the machine started without trouble. Having thus ascertained the cause of the trouble he sent the armature to the makers to be properly repaired.

9.—Semi-enclosed 3-phase alternating-current motor, taking 85 amperes per phase at 360 volts, driving shafting in an ironworks. In consequence of persistent melting of the fuses the Inspector was sent for to ascertain the cause. On testing for insulation he found the stator windings earthed. As far as could be seen through the openings in the front cover of the casing everything appeared to be in order, but on taking off the cover at the pulley end, which was unprovided with inspection poles, and taking out the rotor, the cause of the trouble became evident.

That end of the machine was saturated with oil and covered with dust and the stator windings were burnt in many places by arcs caused by temporary short circuits. Their condition was so bad that the stator had to be entirely rewound. The oil had come from the bearing at the pulley end of the rotor shaft. This bearing was partly inside the casing, and the mouth of its overflow pipe was placed so high that the oil well could be almost filled with oil. This combined with an inefficient guard over the oil thrower and the high speed of the shaft, 750 revolutions per minute, allowed the oil to creep along the shaft and to be thrown on to the windings of the motor.

There seems to be a somewhat widely-held impression that alternating current motors cannot be damaged by oil or dirt. As regards the rotors there is some excuse for the belief, because the difference of potentials between the windings themselves and between the windings and the frames is low, and therefore imperfect insulation may be sufficient to confine the current; but as regards stators the only advantage they have over the armatures of continuous-current machines is this, that they are stationary, and therefore their insulation is less liable to disintegration and will hold out longer in a deteriorated state than if it were subject to the vibration of a moving part.

The above is quite a typical example, 23 per cent. of the failures of alternating-current motors in 1905 being due to this same cause.

10.—Continuous-current 10 H. P. semi-enclosed motor, working with 500 volts at a speed of 1,000 revolutions per minute. The commutator was fitted with four brush spindles each carrying two carbon brushes, ¾in. long by ½in. wide, dovetailed into brass clips. The machine was new in March, and in good order when examined by the Company's Inspector in April, but on May 2nd it broke down. The Inspector then found that two of the carbon brushes which had originally projected ½in. outside the clips had entirely worn away, leaving the gun metal in contact with the commutator. The surface of the latter was much burnt, and grooved in two circles 1/16 in. deep by the gun-metal clips. Evidently the motor had been altogether neglected, as there must have been severe sparking before it could have got into the condition in which the inspector found it. Brush holders, carried by arms hinged on the spindles, are not satisfactory unless provided with stops to prevent the metal brush holders being pressed on to the commutator when the carbons break or wear away.

Nine months latter, *i.e.*, early in 1906, similar neglect brought similar consequences. On this occasion four brushes had worn, and the corresponding gun-metal clips were burnt away.

11. Continuous-current 2-pole compound-wound dynamo, giving 34 amperes at 220 volts when running at 1,000 revolutions per minute. While the machine was running the attendant noticed a smell of burning, and as he was looking for the cause, the armature, to repeat his words, "burst suddenly into flames." When the machine was stopped he found that the armature had been rubbing against the pole pieces, and the heat generated by the friction had set fire to the fibre strips which secured the conductors in the slots in the core plates. The insulation was charred

and many of the conductors short-circuited, also the end of one of the windings was unsoldered from the commutator.

The damage was due to the melting of the white metal in the bearing at the commutator end of the armature spindle.

The case is typical of many others. The ring lubrication so generally applied to the shafts of dynamos and motors requires so little attention that it frequently receives none, and either the oil well is emptied by waste from inefficient oil throwers and shields or by leakage from drain cocks, or else the oil becomes so thick that the rings cease to supply the journal.

It is most desirable that all oil wells should be fitted with gauge glasses, and that drain cocks should have removable handles which should never be left on the plugs to be turned inadvertently.

12.—Continuous-current dynamo, giving 260 amperes at 110 volts when running at 485 revolutions per minute.

At one of his periodical visits the Inspector found the binding nut at the end of the commutator had worked back, so that the bars were held together by the V's in the end ring only, and ready to fly out at any moment. The attendant was not aware that the slackness of the nut was of any consequence. At the owner's request the Inspector explained the nature of centrifugal force and its effect upon the commutator bars. He also took off the brass shields, and showed the attendant how to clean and blow-out the windings, which were in a filthy condition. He then screwed up the nut, and left the machine in working order.

These shields, though no doubt useful for protecting the end connections of the armature from blows, are decidedly objectionable as dirt traps, and the dirt which accumulates in them is often left there indefinitely because the attendant will not take the trouble to remove the shield.

13. — Shunt wound continuous-current 2-pole dynamo, giving 460 amperes at 105 volts when running at 550 revolutions per minute.

About 5 p. m. one evening some of the armature conductors were fused and the steel binders at the pulley end were burnt through. Possibly the binders may have broken first, and by tearing the insulation off the conductors short-circuited them ; but the Inspector who saw the armature soon after the accident was of the opinion that the insulation on the conductors had failed first, for it was little better than a coating of dust upon the copper. The armature windings had to be entirely reinsulated. The commutator also was so much worn that it had to be replaced.

The breakdown was due to the deteriorated condition of the machine. It is a typical case.

14. — Three-phase alternating-current 30 H. P. motor, working at 220 volts and 965 revolutions per minute. The rotor was of the squirrel cage type, 15 in. diameter, 10½ in. long, carried on a 1¾ in. shaft running in bearings with gun-metal bushes 5 in. long and 16 in. from centre to centre. The air gap was 1-32 in. when the machine was new, but in less than six months both bearings had worn down sufficiently to bring the rotor into contact with the stator poles. The heat developed by the rubbing friction melted the solder in the junctions of the short-circuiting rings and bars.

The air gap in this case was perhaps slightly less than usual, but in modern machines it is always small, and therefore it is very necessary to lubricate and watch the shaft bearings carefully and to gauge the clearance frequently.

16. — Continuous-current dynamo, giving 200 amperes at 210 volts when running at 950 revolutions per minute. The armature windings were laid symmetrically on a smooth core with four driving plates of brass, and insulated from it by a layer of fibre which was not turned over the edges of the end-plates ; the conductors, therefore, where they passed over these edges, had no insulation beyond the cotton coverings, which, as the edges were sharp and rough, were soon worn through. After repeated failures of the insulation at these points the armature was burnt out so far as to need rewinding. It was at once sent away to be repaired, and the Inspector did not see it till it had been stripped and partly rewound. He found that fibre was being used as before to reinsulate the core, and that the end plates over which the conductors had to pass were in the condition described above. He ordered the winding which had been put on to be removed, the end plates to be turned smooth and rounded on the edges, and the core and ends to be insulated with presspahn, with a double thickness over the rounded edges of the end plates. Four additional binders were also put on, it being found that the three originally fitted were not sufficient to hold the driving plates and conductors immovable.

17.—The following is a somewhat similar case.

Continuous-current motor 9 H. P., 110 volts, running at 600 revolutions per minute. The armature core, 8 in. long, was made up of soft-iron discs, No. 24 S.W.G. .022 in. thick, and 14 in. diameter threaded on the spindle, and secured by nuts, and winding drums 12 in. diameter a teach end. The conductors were laid in slots ⅞in. deep lined with micanite about .05 in. thick, and further insulated by thin layers of presspahn.

Owing to the absence of proper end plates or slotted flanges on the winding drums, there was nothing to hold the core plates together at their periphery, and in some way, possibly in putting in or taking out the armature, they had been separated slightly from each other, and the length of the armature measured parallel to its axis had been increased from 8in. at the bottom of the slots to 8½ in. at the circumference. The slots in which the conductors were carried were therefore ½ in. longer at the top than at the bottom, and as the insulating troughs were little more than 8 in. long (the length of the core at the bottom of the slots), it followed that the upper edges of the teeth at the ends of the core plates extended up to or beyond the insulating lining, and were in contact with cotton covering of the conductors, which their sharp edges easily cut through. Several conductors were in consequence short-circuited and burnt.

These two cases are representative of many others which justify a general statement that sufficient attention is not paid by many makers to the protection of armature conductors at the points where they leave the cores. The same insufficient insulation is frequently found at the edges of winding drums.

18. A common cause of damage to the field coils of shunt-wound motors and to the no-volt release coils of starting switches, is high voltage generated by induction on breaking shunt circuits.

Many starting switches are so designed that this occurs whenever the double-pole control switch on the supply is opened while the armature is standing. The diagram Fig. 4 shows one such arrangement. It is selected not because it is worthy of special reprobation, but simply because the drawing happened to be at hand. The switch was used for starting a 4 H. P. continuous-current shunt-wound motor working at a pressure of 500 volts. The diagram shows the starting switch *a b* closed, the resistance cut out of the armature circuit and the single-pole main switch *c d* held in by the no-volt revolt release magnet. These are the positions of the switches while the motor is running. To stop it the current is cut off by opening the double-pole control switches *e f*. After the current is cut off the armature continuing to resolve by its own *vis viva* becomes a dynamo generating current

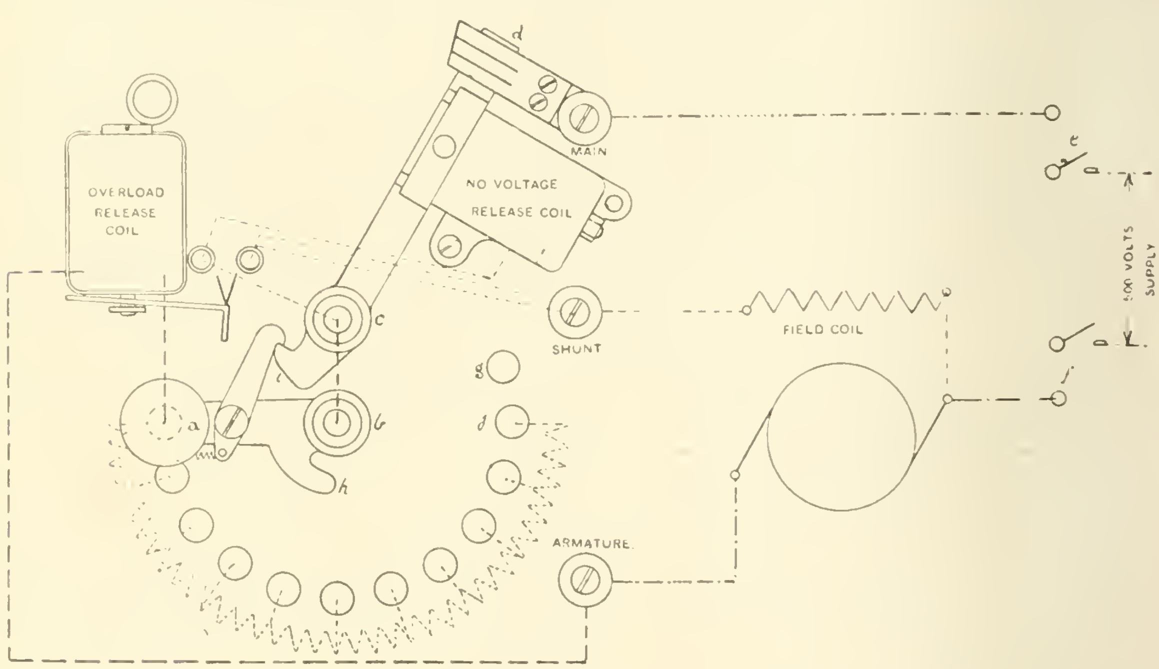


Fig. 4.

and exciting its field magnets. As the speed decreases so does the shunt current, until in time the no-volt magnet fails to hold the switch *c d*. This being released, the resistance switch *a b* flies back under the action of the coil spring on the spindle *a* to the off position *g*, and the projection *h* engaging with the heel *i* of the main switch *c d* closes the latter again. If while the switches are in these positions the double-pole control switches *e f* be closed and then reopened, as they might be if the intention to start the motor were abandoned, the shunt circuit would be broken while excited by the full voltage of the supply. The electromotive force thus generated would severely try and probably before long break down the insulation of the shunt circuit. To avert the danger the "off" contact stud *g* should be connected electrically to the first contact *j* of the resistance or this last to the switch arm *c d*, or else the resistance switch *a b* should be prevented from going beyond the first resistance contact *j* and the projection *h* should be shaped to close the main switch *c d* when *a b* rests on *j*. In either case the shunt circuit would remain closed on the armature and no inductive effect would follow the opening of the control switches *e f*.

19. — Continuous-current shunt-wound 40 H. P. motor, taking current at 400 volts. The commutator was 12 in. diameter by 5 in. long. The bars, 147 in number, were insulated from each other by compressed mica, sometimes called micanite, a substance which seems to be composed of small flakes of mica cemented together with shellac and consolidated by hydraulic pressure. Constant trouble was experienced from short-circuiting of adjacent bars causing heating and melting of the solder at the joints of the armature conductors to the commutator. Finally, the armature had to be sent back to the makers for repair. The Inspector who saw it found the cement between the flakes of mica had worked out and been replaced by dust from the carbon brushes. To this the short-circuiting of the bars was due. The Company advised the owner to have the commutator entirely reinsulated withe pure mica, carefully chosen to wear down equally with the copper bars, but to save a little time he preferred to have it repaired with the original material. This was done twice at short intervals, and then the Company's advice was taken. The commutator has not failed since.

This is again a typical case. The same trouble is experienced with the compressed mica rings now almost universally used for insulating commutator segments from binding washers at the ends; but here the remedy, is not so easy to prescribe, for the rings must be of some material which can be moulded to fit the V-shaped ends of the copper bars, besides being at the same time homogeneous, non-hygroscopic, non-conducting, impervious to oil and dust, and able to withstand heat and pressure, and a certain amount of "fridging" which it is difficult to prevent.

The discovery of such a material would be a great boon to users of electrical machinery, for a large percentage of the breakdowns of motor commutators are traceable to the use of compressed mica. The percentage in 1905 was 63 per cent., and it would doubtless have been greater had the cause of all the breakdowns of motor commutators been ascertained.

It is curious that no failures of dynamo commutators were attributable to this cause. Possibly the difference in the behavior of the two classes of machines may be accounted for by the facts that (1) many motors are supplied from 3-wire systems with the middle wire earthed, so that the insulation has only to withstand half the full voltage of the supply, and (2) many dynamos have copper brushes which work cooler and make less dust than carbon.

EXPORT DUTY ON ELECTRIC POWER.

The Dominion Government has introduced a bill in Parliament to regulate the exportation of electricity and other fiuids such as petroluem and natural gas. The measure is called "The Electricity and Fluid Exportation Act," and provides as follows :

"No person shall export any power or fluid without a license, or no power or fluid in excess of the quantity permitted by such license ; provided that any person who immediately prior to the passing of this act is lawfully engaged in the exportation of power or fluid, shall not, with respect to such exportation, be subject to the provisions of this act, until three months after this act goes into force, or until he has sooner obtained a license under this act ; provided, also, that his exportation does not at any time during the interval rateably exceed in quantity of power or light, the amount which he was exporting prior to the passing of this act.

"No person shall, without a license, construct or place in position any line of wire, or other conductor for the exportation of power, or any pipe line or other like contrivance for the exportation of fluid.

"Subject to regulations of the Governor in Council in that behalf, the Minister may grant licenses subject to such conditions as he thinks proper for the exportation of power or fluid, where such power of exportation exists by local authority ; and such licenses shall be revocable upon such notice to the licensee as the Minister deems reasonable in each case.

"Any such license may provide that the quantity of power or fluid to be exported shall be limited to the surplus, after the license has supplied for distribution to his customers for use in Canada power or fluid to the extent defined by such license, at prices and in accordance with the conditions, rules and regulations prescribed by the Governor in Council.

"Every such license shall be revocable at will by the Minister if the licensee refuses or neglects to comply with any of the conditions imposed with regard to the supply and distribution of power or fluid in Canada.

"Subject to any regulation of the Governor in Council in that behalf, the Minister may grant licenses for the construction, placing or laying of any line of wire or conductor for the exportation of power, or of any pipe line or other like contrivance for the exportation of fluid.

"Every person who exports any such power or fluid contrary to the provisions of this act shall for each day on which any such export took place be liable to a penalty not exceeding $5,000 and not less than $1,000.

"Every person who, contrary to the provisions of this act, places or lays in position any line of wire or other conductor for the exportation of power, or any pipe line or other like continuance for the exportation of fluid, shall for each such offence be liable to a penalty not exceeding $5,000 and not less than $1,000, and to forfeiture and confiscation of such line of wire or other conductor, pipe line or other contrivance, which may forthwith upon such conviction be destroyed or removed by direction of the Minister.

"The Governor in Council may by proclamation published in The Canada Gazette impose duties not exceeding $10 per horsepower upon power exported from Canada, or not exceeding ( ) cents per cubic foot of fiuid exported from Canada, and such duties shall be chargeable accordingly after the publication of such proclamation.

"The Governor in Council may by proclamation published in The Canada Gazette exempt from the payment of such duties such persons as comply with the direction of the Minister with regard to the quantity of power or fluid to be supplied by such persons for distribution to customers for use in Canada."

THE LATE WALLACE C. JOHNSON.

The death occurred at Niagara Falls, N. Y., on December 15th last, of Mr. Wallace C. Johnson, one of the best-known expert hydraulic engineers of the continent. The late Mr. Johnson was a resident of Montreal for four years, coming to Canada in 1899. In 1900 he was appointed chief engineer of the Shawinigan Water and Power Company, and the work there was carried out under his direction. Mr. Johnson was the engineer for several other Canadian construction works at Chicoutimi, Cornwall, and other smaller towns.

Mr. Johnson's work in the United States was of a

THE LATE WALLACE C. JOHNSON.

very important character. He was the chief engineer of the Niagara Falls Hydraulic Company, and superintended the construction of the first large station at that point. At the time of his death he was employed by a commission in the state of New York for the development of water powers in the various rivers and streams.

Mr. Johnson was regarded as an expert in all hydraulic matters, and was the author of books on the subject. While in Montreal he was a popular member of the St. James' Club and the Engineers' Club, and was also a member of the Canadian Society of Civil Engineers. Deceased was fifty years of age, and leaves a widow, but no family. The immediate cause of death was Bright's disease.

SPARKS.

During the past season the Montreal Street Railway has renewed twenty miles of track. The company now has 2,300 employees, including 1,800 conductors and motormen.

Good progress is being made in building the Georgian Bay Power Company's plant at Eugenia Falls. The tunnel through the mountain will be 869 feet long, on which some excavation has yet to be done. Most of this is rock.

IMPROVED VARIABLE SPEED GEAR.

A device which has attracted considerable attention in Great Britain, and which is about to be manufactured at Hamilton, Ont., is the S. & S. variable speed countershaft. The ideas embodied in this gear were originated by Mr. Bernard E. Scriven, formerely of Hamilton, who leased the British rights to J. W. Knowles & Sons, Limited, who have been manufacturing the gear during the past year. The Canadian branch of the S. & S Engineering Company is at 255 Jackson street west, Hamilton.

The general arrangement of the apparatus can be seen in the accompanying illustrations. It consists of two tubular shafts, supported in long bearings, which form part of the two cast iron overhead brackets, these in turn being rigidly bolted to a substantial base. Each of the shafts carries one expansion and an ordinary pulley, one of these shafts being driven from the main shaft, and the other intended for driving the machine or tool. The variation of speed is obtained by simultaneously altering the diameters of the two expansion pulleys. As the diameter of one expansion pulley increases, that of the other decreases.

The expansion of the pulleys is brought about in the following manner:—The boss of the expanding pulley is large, and the spokes pass through machined slots in it. The spokes have teeth cut on their edges for the greater part of their length inside the boss: these teeth gear with a broad pinion, which is revolved by the insertion or withdrawal of a spindle with helical keyways cut in it, which can be moved backwards and forwards inside the pulley shaft, which is hollow. The grooved end of the spindle for the front expanding pulley can be moved in and out by means of the chain wheel and gearing. The two

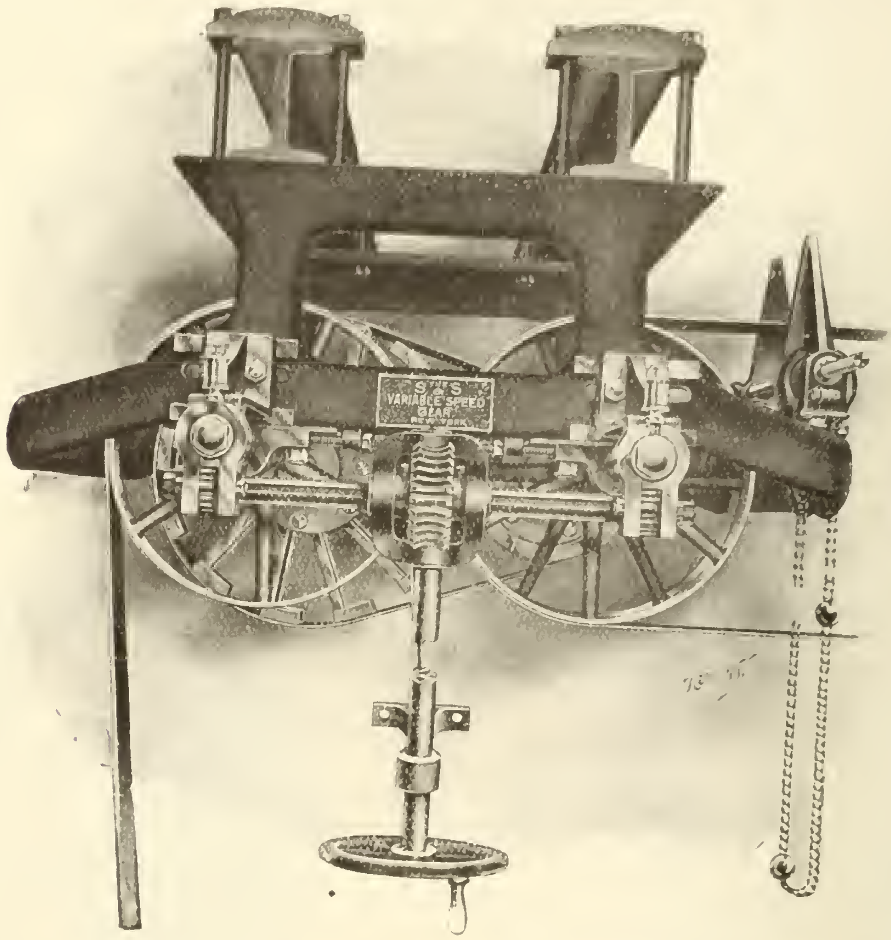


FIG. 1.—SIDE VIEW.

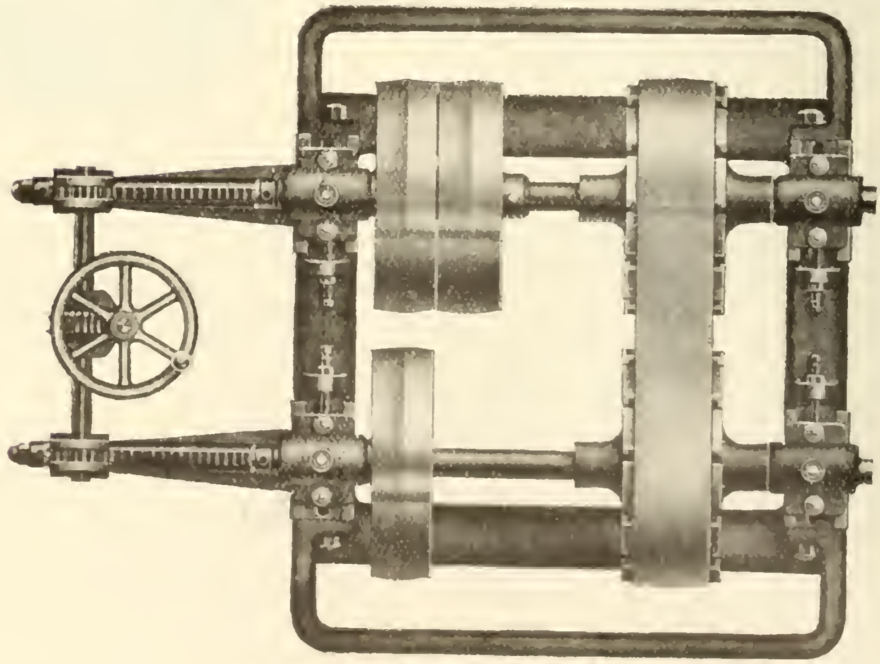


FIG. 2.—PLAN VIEW.

regulating spindles for the two expanding pulleys are geared together, so that the motion of one bears the correct ratio to the motion of the other, and hence the diameters of the pulleys are always kept in correct ratio. All the spokes are moved in or out equally, and consequently pulleys of true polygonal form but ehanging diameter are made by any movement of the actuating spindles or draw bars.

In the S. & S. variable speed gear they employ a very short drive between the two expansion pulleys, the S. & S. being, it is claimed, the only type of belt pulley that can be connected up in this way and produce satisfactory results. The reason of this is that they do not depend upon the sag and elasticity of the belt for the grip, as their expansion pulleys are designed to contribute this elasticity themselves, hence they have all the advantages of a long drive on short centres, each size allowing a certain amount of give to the rim sections, proportionate to the amount of h. p. it is desired to transmit. This feature, together with the advantage of having air gaps between these said rim sections, provides for any irregularities and insures a steady tension of the transmission belt at every portion of the range.

The Canadian Branch of the S. & S. Engineering Company are preparing to manufacture these gears in fourteen different sizes capable of transmitting up to 128 h. p. at a ratio of approximately 4 to 1. Their experience in England has enabled them to eliminate all minor difficulties, with the result that they guarantee a gear that will run right and possesses many advantages.

MOTOR-GENERATOR CONTRACT.

The Allis-Chalmers Company have recently been awarded a contract for three motor-generator sets to be used in an extension of the works of the Niagara Electro-Chemical Company at Niagara Falls, N. Y. The sets are of the synchronous type operating at 500 R. P. M., 25-cycles, 2200 volts. Each set consists of three machines, the synchronous motor being coupled to a D. C. generator at each end by means of flange couplings. Each D. C. machine generates current at a maximum pressure of 165 volts and has an output of 200 k.w., the voltage being capable of variation through a considerable range. The sets have four bearings and the design is such that either D. C. machine can be disconnected, in case rep irs are necessary, without interfering with the operation of the remaining machine.

The service which these sets have to perform is exceptionally severe, as the load is continuous day and night for several weeks at a time, without opportunity for a shut down of any kind. The current is used for the electrolytic reduction of metallic sodium from sodium hydroxide, and the process is an uninterrupted one. Each d.c. generator furnishes current to a series of pots in which the electrolytic reduction is carried on, and by using three-machine sets the voltage on the series of pots supplied by any machine can be varied independently, thus giving a decided advantage over a single d.c. machine of twice the output.

Each set will be provided with a three panel switchboard, one a.c. motor panel and two d.c. generator panels. The sets will be arranged for starting from the d.c. end and the synchronous motors will be excited from the d.c. machines. Power for operating will be supplied from the large plant of the Niagara Falls Power Company.

PERSONAL.

Mr. Charles Brandeis, electrical and mechanical engineer, Montreal, has gone to Havana, Cuba, on a two weeks trip.

Mr. R. H. Eldon, B. A., has been appointed Principal of the Toronto Technical School, in succession to Dr. W. Pakenham, who is now Dean of the Faculty of Education of the University of Toronto.

Mr. Arthur Lineham, who has occupied a responsible position with the British Columbia Electric Railway Company for the past fifteen years, has tendered his resignation to engage in the real estate business.

Mr. E. Irving, manager of the Sunbeam Incandescent Lamp Company of Canada, was in Chicago for a few days recently attending the Electrical Trades Exhibition.

Application has been made to wind up the British-Canadian Engineering Company, organized in Toronto a couple of months ago.

MUNICIPAL PLANT SHOWS A DEFICIT.

The Ottawa Electric Commission has reported that the deficit for the half year ended November 30th was $2,658. The plant has 2,173 customers. Merely a fraction of the ratepayers of Ottawa benefit, but all are privileged to share in making good the loss.

CALENDARS.

The customers and friends of the Conduits Company, Limited, manufaeturers of "Galvaduct" and "Loricated" eonduits, Toronto, have been favored with a combined desk calendar and thermometer, accompanying which is a neat little booklet extending their best wishes for a Prosperous and Happy New Year, and expressing their appreciation of the many courtesies they have received during the year.

TRADE NOTES.

The Chase-Shawmut Company have recently disposed of their patented switchboard interests to James S. Pennefather, of New York.

The Wire & Cable Company, Montreal, have been awarded the contract for the necessary telephone wires and cables and fire alarm wires and cables for the City of Edmonton, Alberta.

The Canadian General Electric Company announce that, owing to recent advances in the cost of raw materials, they have been compelled to withdraw all discounts applying to general supplies and materials listed in their catalogue and to revise their price list based on present conditions.

The Piqua Blower Company, of Piqua, Ohio, is being incorporated, with a capital of $50,000. This company will take over the interests of the Piqua Foundry and Machine Company, and will make a specialty of the manufacture of Positive blowers and gas exhausters as developed by the latter company during the past two years.

Another large order for Shawmut soldered rail bonds has recently been placed with the Chase-Shawmut Company, of Newburyport, by the Northern Electric Company of Chicuo, California. This order is for 138,855 bonds and was placed in connection with two other orders, one for 33,500 bonds and the other for 61,000, making a total of 243,355 bonds.

The Canada Metal Company, Toronto, have purchased the Toronto Ball Grounds cccupying 3½ acres adjacent to the Grand Trunk and Canadian Pacific Railway in Parkdale, and will next fall commence the erection of two bu ldings 40 feet wide by 500 feet in length, the railroad site being run between the two buildings, which will be of concrete fire-proof construction, one two storeys in height and the other one storey.

Specifications are being drawn up for a new electric lighting contract in Montreal, to take effect upon the expiration of the present contract in December, 1908. The new contract, it is proposed, shall cover a period of fifteen years and must include public lighting by arc and incandescent lamps, as well as electric current for private consumers. In this connection, instructions point out that the city at present makes use of 1,520 arc lamps, 90 incandescent lamps of 65 candle-power, and 335 incandescent lamps of 32 candle-power for public lighting in streets, avenues, lanes, parks and other public places in the city. As a guarantee of good faith, tenderers will have to make a deposit of $150,000 with the city treasurer, without which no tender will be taken into consideration. If this deposit is retained for any length of time, interest at 3 per cent. will be paid tenderers by the city. Once the contract is awarded, it will mean an exclusive contract, and franchise will be given to the successful tenderer for a period of fifteen years, dating from January 1, 1909. A distinction is made between the public lighting and the supply of current to private customers. In the latter case it is recognized that the privilege will be a general one, but the proposed contract does not provide for an exclusive franchise, as in the case of public lighting. It is, however, proposed that the privilege of supplying electric light to private individuals shall cover a period of twenty-five years, instead of the fifteen-year franchise for street lighting.

ELECTRIC WIRING RULES IN TORONTO

A meeting of the leading electrical firms of Toronto was held in the rooms of the Employers' Association, 18 Victoria Street, on January 9th. It was the outcome of an impromptu meeting suggested by one or two prominent contractors to discuss the conditions generally and also the advisability of adopting certain suggestions contained in the No. 8 Bulletin issued by the Electrical Department of the Canadian Fire Underwriters' Association. When the meeting was called to order, there was quite a representative gathering of the electrical trades of Toronto.

Mr. H. F. Strickland, Electrical Inspector of the Canadian Fire Underwriters, was requested to take the chair. The chief point under discussion was the advisability of adopting a suggestion in the No. 8 Bulletin that outlet boxes be provided for all outlets, the result being that the suggestion was endorsed. It was then decided on a subsequent resolution that the question of enforcing these boxes be held in abeyance until a later date when some approved box or fitting would be placed on the market and a satisfactory selection made therefrom, at which time the rule would be duly enforced, after having given the trade a reasonable notice.

The other suggestions in the No. 8 bulletin were all discussed and were unanimously accepted. We understand that there is nothing in the No. 8 bulletin with the exception of the outlet box question that is not provided for in the National Code, the requirements being more or less an interpretation of the enforcement thereof. By way of explanation regarding the use of wire for inside work, the Electrical Inspector states that properly speaking all inside wiring should have rubber covered wire, except in very dry or inflammable places where slow burning weatherproof is probably better and will be accepted.

The attention of the Electrical Trade throughout the country is directed to the difference between slow burning weatherproof wire and ordinary weatherproof wire. The class of slow-burning weatherproof wire which is called for is that which is finished with the braid on the outside, that is to say, it has a smooth, hard, black finish, to which lint or dust will not adhere. In other words, ordinary weatherproof wire is to be entirely excluded for inside wiring.

The use of screws instead of nails for knob and tube wiring or for any wiring should be carried out and will be enforced. The experience of the Inspection Department in the city of Toronto and elsewhere shows that nails are not strictly a first-class job and many cases are found where poor nails are used, allowing the knobs to be bent over and in many cases split or otherwise damaged by the use of the hammer.

It is advisable, and is pointed out in the No. 8 Bulletin, that all cellars and damp places should be wired so that brass sockets, flexible cord and wall brackets be avoided, the advantages of this being obvious. There is no doubt that there is a certain fire hazard from handling such fittings in damp basements, especially where transformers are in use, and it is advisable to keep all cellars and such places wired in such a way that the lights will be well up to the ceiling and controlled by wall switches. The general rule in the No. 8 Bulletin calls for condulets, which it is claimed are practically the only fitting which complies with the requirements. The suggestions contained in the use of these fittings and the many applications thereof, have proved to be a step in the right direction.

Another question under discussion was the use of different colored wires in connection with inside wiring, more directly in relation to concealed work, the object being to maintain a black core wire as the neutral or grounded wire on all installations in the city of Toronto, the object being to provide for a possible increase of voltage which is likely to occur at no distant date in the city of Toronto. Wiremen will therefore use the black core wire as the neutral or grounded wire and in putting on single pole switches, the black wire will pass through and the switch will break the positive wire. By adapting a black core wire for the neutral and any other color the wire man may desire for other wires, the neutral wire is always discernible. The question of having the electric fixtures wired in the same way by the electric makers is to be taken up by the Canadian Fire Underwriters, so that the black wire will be maintained throughout.

Regarding the adoption of new code fuses, the same bona-fide arrangement will be extended to contractors that has heretofore characterized the Inspection Department, namely, that they can use up what they have on hand in the way of plug cut-outs, and while the 250 volt current may be applied thereto, it will only be necessary to change the plug. It is of course expected that contractors will not use their plug cut-outs up on new work, where new code cut-outs have been specified, but will exhaust their present supply on small risks, where they could be used to advantage.

At the conclusion of the meeting it was moved by Mr. John Taylor, of the John Ritchie Company, and seconded by Mr. Shields, of W. J. McGuire & Company, that a vote of thanks be tendered to Mr. H. F. Strickland, Chief Electrical Inspector of the Canadian Fire Underwriters, for his earnest work on behalf of the adoption of standardized wiring rules.

All the rules of the National Code bearing on electric wiring and other general work are now pretty well standardized, and with the co-operation of the electrical contractors and others interested, the Electrical Inspector hopes to keep all rules well observed and gradually bring the electrical trade to a condition where it will be satisfactory to all parties interested and thereby reduce the fire risk and make it thoroughly satisfactory to the Fire Underwriters' Association.

BULLETIN NO. 8.

In issuing this No. 8 bulletin, this Department desires to thank the electrical trade for their co-operation during the past twelve months, in connection with the standardizing of electrical work, and to submit some further points which will require to be standardized to comply with modern requirements, and also to prepare for what is inevitable in Toronto, namely, the increasing of the lighting voltage from what it is at present to 240-480 volt three wire system.

In anticipation of this increase in voltage, we desire that all sesuf in connection with incandescent wiring be immediately substituted by new code standard cut-outs, equipped with approval enclosed fuses. This will mean so far as the city of

Toronto is concerned, the complete discarding of all other styles of fuses. In factory work and other places where drop-lights are to be used, the use of fused rosettes is to be entirely abandoned. Generally speaking, the observance of the separation of wiring in concealed work will have to be more carefully regarded, and while we will not expect the full 10" between wires of opposite polarity, we will expect that the wiring in such places will he more spread than it is at present, and that the running of wires underneath bath-rooms, where they are liable to come in close proximity to water pipes, be carefully avoided.

The foregoing requirements are asked for immediately, and we beg to notify all parties interested that on and after January 1st, next, that the use of nails in connection with insulators is to be discontinued, and we expect that they will be securely fastened with screws. Also the use of ordinary weather-proof wire is to be prohibitive on and after January 1st, and for all inside work, slow burning weather-proof wire is to be used, except in damp places, in which locations approved rubber covered wire may be used.

Aerial service wires in pipe or otherwise must not be concealed in walls or partitions before entering cut-out and switch. All branch circuits of two wires from centre of distribution to lamps should consist of a black and a white core wire, being colors easily distinguished, the black wire being merely maintained as the neutral or grounding wire and the white for the positive, so that the mistake of placing the single pole switch on the black wire may be avoided.

In bath-rooms, cellars or any place where it is liable to be damp or where a person is liable to stand and touch wires, outlets should be on the ceiling. All electrical contractors should endeavor to keep the receptacles, sockets and fixtures throughout an installation polarized, so that the black or neutral wire shall be always on the shell side of the socket or lamp. Parties installing electric fixtures are strongly advised to have them thoroughly inspected and contractors are urged and requested to pay particular attention to the making and finishing of joints under canopies.

BASEMENTS.—In connection with lighting throughout basements, except in special cases where circumstances will not warrant it, it would be advisable to discard the use of brass sockets and ordinary flexible cord, and in place of this to have lighting throughout basements accomplished by suitable receptacles on the ceiling or short drops with hard rubber keyless sockets, the same to be controlled by switches.

The grounding of conduit service pipes requires careful attention. Under ordinary circumstances the code requires that the ground wire shall be large enough so that in case of any ground in the pipe taking place, it will be large enough to blow the largest fuse in the circuit without injury to the pipe, and as the wires in the circuit pipe are directly connected to the street service, it would require a ground wire to be not less than No. 8 B. & S. gage. This rule must be rigidly observed.

SPECIAL RULES GOVERNING THE INSTALLATION OF ELECTRIC SIGN FLASHERS.

The following rules governing the installation of electric sign flashers and other commutating devices are to go into effect on January 1st next, and it is expected that these requirements will be closely adhered to.

COMMUTATING DEVICES—UNDER 125 VOLTS.

1. Mechanical commutating devices must be mounted on an insulating non-absorbent and fire-proof base and so constructed that no part of their mechanism is any part of the electrical circuit, except the actual switches used in such device.

2. Switches of such device must open twice the distance that is required to break the rated load and must be able to operate for one hour at an overload of 100% without material injury to the apparatus.

3. Must be so constructed and connected that all wires leading therefrom break double or triple pole or more than six amperes per circuit.

4. Must have the maker's name, together with the rated capacity in volts and amperes, clearly shown on a metal name plate.

5. Parts of such apparatus carrying current of opposite polarity must conform to rules—in regard to separation of metals and break distances.

6. The construction of all switches in such device must be such that they will carry five times their rated load without undue heating at any point.

7. Must use soldered lugs for connecting to terminals on all loads greater than 15 amperes.

8. Must be kept properly lubricated and cleaned at all times and surplus of oil must not be allowed to accumulate on the apparatus or soak into the base supporting the device.

9. Must be enclosed on all sides with a fire-proof case and where fire-proof material is not used the latter must be protected with a fire-proof lining.

10. Wiring must not be run to or from such device in such manner as to make it liable to injury by coming in contact with the moving parts of such device.

11. Must, for all devices under 250 volts, have double pole cut-out and snap switch for motor driving said device, mounted on the same base, and over this voltage individual line cut-outs and knife switches.

12. Must not be installed in inaccessible or difficult places to be gotten at, such as in the bottom of boxes, under show windows, etc., and rubbish must not be permitted to accumulate near the flasher case.

13. Must be protected with an approval service switch properly fused to the rate capacity of the device.

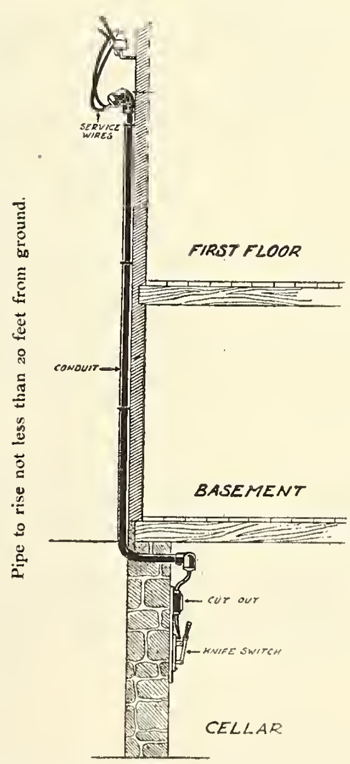
14. Cut-outs controlling sub-circuits must be within 10 feet of the commutating device.

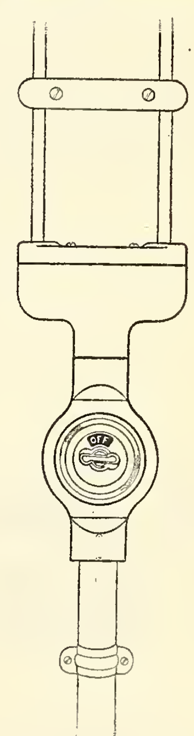
15. On all loads of more than 60 amperes, switches must open one additional inch for each 30 amperes over this amount either in one break or a number of series breaks.

16. Commutating devices breaking a greater voltage than 250 must conform to the foregoing aud such other rules as are required for this voltage in current breaking apparatus. All breaks must be 8 inches or more either in one break or a number of series breaks, and no parts of such device can be less than 6 inches between metals of opposite polarity at any point.

GENERAL.

We wish to again remind parties interested that at all points where wires emnate from conduit pipes either in concealed





work or otherwise, that they must be provided with an approved fitting, so constructed that each wire will leave separately and be insulated from one another by a non-absorptive, non-combustible material, there being such devices on the market at the present time. See cuts herewith illustrating methods of using these devices.

The Saraguay Electric Light & Power Company have purchased a 200 k.w. Westinghouse generator direct connected to a cross-compound condensing steam engine purchased from Belliss & Morcom, of Birmingham, England.

The property of the Southern Light & Power Company at Erindale, Ont., together with pole lines and other real estate, which was placed on the market as the result of the liquidation of the York County Loan Company, was purchased by the Stark Telephone, Light & Power Company for $47,500.

SPARKS.

Plans have been prepared for extending the electric light plant at Edmonton, Alta.

The Beaudry Gasoline Engine Company has been registered in Montreal by Mr. A. Beaudry.

Application has been made for a winding-up order for the Keystone Engineering Company, Limited, Toronto.

The James H. Wylie Company have installed an electric plant in their woollen mills at Almonte, Ont.

Mr. Charles A. Mackey has registered the business of the Century Electric Company, electrical contractors, Montreal.

Mr. Willis Chipman, C.E., of Toronto, has recommended the installation of a combined waterworks and electric light plant at Estevan, Sask., at an approximate cost of $63,000.

Mr. C. Brandeis, C.E., Montreal, has been appointed consulting engineer for the British North American Lumber Company of Quebec for the installation of an extensive lighting plant.

The Perth Electric Company, Limited, has been incorporated at Perth, N.B., with a capital of $9,000. The provisional directors are Messrs. S. J. Brown, J. W. McPhail, C. L. Olmstead, and George E. Armstrong.

Notice is given that an application will be made to the Manitoba Government for an act to incorporate a company under the name of the Suburban Electric Railway Company, with power to construct and operate a line or lines of railway with steam, electric, gasoline or other kind of motive power, for the conveyance of passenger and freight from Winnipeg westerly and northerly to a point at or near the shore of Lake Manitoba, in the province of Manitoba.

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SPARKS.

Messrs. Horner & Watson have installed an electric plant at West Shefford, Que., and will light the streets.

The transfer of the electric light plant at Carman, Man., to the Corporation was officially completed last month. The price which the town pays for the plant is $19,877.17.

Hon. Peter McLaren, of Perth, Ont., is installing an electric plant to furnish light and power in and about his home.

The Town Council of Seaforth, Ont., decided against the submission of a by-law to the ratepayers guaranteeing the bonds of the Maitland Power Company to the extent of $50,000. As previously announced, this company propose developing a water power on the Maitland river.

Work is progressing rapidly on the surveys for the new power plant at Point du Bois for the city of Winnipeg. All supplies are now shipped from Lac du Bonnet station by dog team, one team of four dogs being able to handle but 450 pounds under favorable conditions. The difficulty of getting in supplies has been due to the heavy snowfall and the thin ice on the river.

The British Columbia Electric Railway Company have completed the extension of their light and power system to Ladner. The work covered a pole-line of twenty-two miles, and the crossing of the Fraser at New Westminster was a difficult piece of work, owing to the requirements of the Government. At this point the line may boast of being the highest transmission line in the world, two towers being three hundred and twenty feet above water-level, with a span of two thousand feet between them. The line has been constructed under contract with Mr Macdonald, former line foreman of the company, and its speedy completion is a credit to his knowledge and skill

SPARKS.

The Cobalt Power Company, Limited, was recently incorporated by the Ontario Government, with M F Beach, A Broder, C A Beach, B C. Beach and M W Beach as provisional directors

Mr G V Reid, superintendent of the electric plant at Moose Jaw, Sask has recently tendered his resignation to accept the position of superintendent of the electric power and telephone systems at Kenora Ont, at a salary of $2,000 a year

An electric railway running through Canadian territory between Detroit and Buffalo is said to be the scheme behind the application of the Twentieth Century Transportation Company for the ferry franchise between Windsor and Detroit The proposed route of the line is said to be through Ridgetown St Thomas and Welland to the Niagara frontier

SPARKS.

The proposal of the Hydro-Electric Power Commission in respect to Niagara power was almost unanimously adopted by the municipalities where votes were taken on January 7th. Hamilton, London, Stratford, St. Thomas, Guelph, Galt, Woodstock, Ingersoll, St. Mary's, Waterloo, Preston, Hespeler, Toronto Junction, Weston and Paris voted in favor of entering into a contract with the Commission, while a negative vote was given by the citizens of Brantford.

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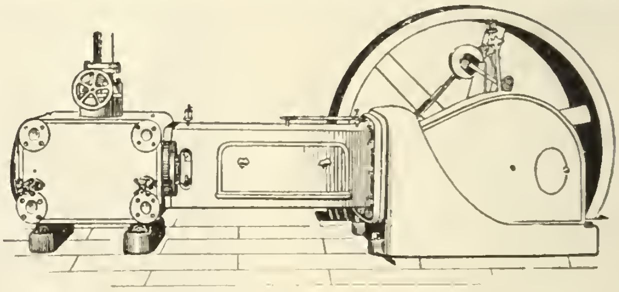

PUBLICATIONS.

The Canadian General Electric Company have placed on the Canadian market the "Equoipoise" telephone arm, which is described in a recent pamphlet. This arm saves all desk room and is a very convenient arrangement. The price of a 24-inch arm is $4.50 and a 30-inch arm $5.00.

Westinghouse type "C" integrating watt meters are described in a recent folder published by the Canadian Westinghouse Company, Hamilton, Ont. The induction motor principle as the basis for its watt-meter design was first adopted by the Westinghouse Electric & Manufacturing Company, and it is a significant fact that the original design has remained substantially the same.

The Chase-Shawmut Company have just issued their new bulletin, No. 36, which they are distributing to the trade. This is a twelve-page pamphlet in which is listed all of their lines of fuses and fuse fittings. The new N. E. C. single pole barrier porcelain bases are now on the market. This line includes both the 30 and 60 amp. classes for 250 and 600 volt The double and three pole 100 amp. N. E. C. porcelains are listed here as well. On the last page is listed the Shawmut extended terminal fuse, which they have recently put on the market.

The "Canadian" turbine as manufactured by Charles Barber & Sons, of Meaford, Ont., is very fully described in a new catalogue issued by that firm, who have now entered upon their fortieth year as manufacturers of turbine waterwheels. They point out that in 1880 the Dupont Powder Company, of Wilmington, Delaware, had 18 wheels tested in Baltimore, and that the "Canadian" turbine registered the highest efficiency in this test, beating all the wheels tested at Philadelphia, including the Risdon wheel, which had been given a standing of 87 per cent. there. The latest Holyoke tests show that they work well over 80 per cent. and carry this over the full working part of the gate at constant speed, having never been beaten in a practical test.

"Hawthorne Works" is the title of a little booklet just issued by the Western Electric Company, of Chicago, for distribution to the trade. The booklet contains a description of the new works of this company at Hawthorne, Illinois, for the manufacture of power apparatus. Since the completion of this new plant, the company are in a position to build heavy power apparatus and switchboards. The buildings consist of office, pattern shop, pattern storage, foundry, forge shops, and machine shops, devoted to the manufacture of direct and alternating current motors and generators, and cable and rubber plants. In addition to these buildings, there is a gas plant, water tower, power plant, two crematories, freight house, and round house for locomotives. The illustrations in the booklet show the magnitude of the works and the splendid facilities for receiving and shipping heavy machinery.

The City Commissioners of Edmonton, Alta, have been given power to purchase a three-million gallon turbine pump for the waterworks system.

The Town Council of Brampton, Ont., have made a new contract with the Brampton Electric Company. The agreement will come into force July 1st, 1907, for a term of five years, renewable at the end of that time for another five years under the same conditions, unless either one party or the other has given six months' notice to terminate it. The agreement provides that the lights shall be kept burning in the streets "from dark until 1.30 a m on each dark and cloudy night," and "in any event on 281 nights in each and every year of the said term, it being understood and agreed that the said lights shall be kept lighted and burning on every night when and so long as the moon is not shining, and when even though it may be in the light of the moon, the same is obscured by clouds." The contract calls for 33 arc lights and 32 incandescent of 32 candle-power in the streets. The amount to be paid the Electric Company by the town has been fixed at $2,250 per year, paid quarterly.

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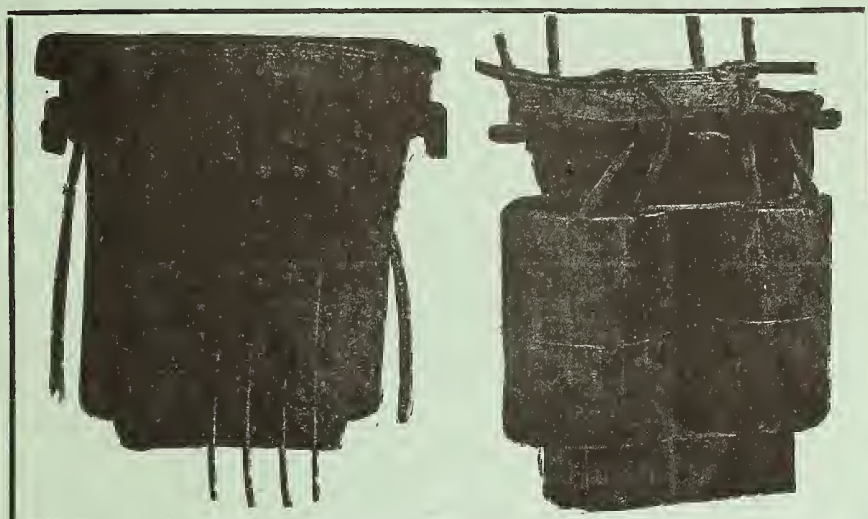

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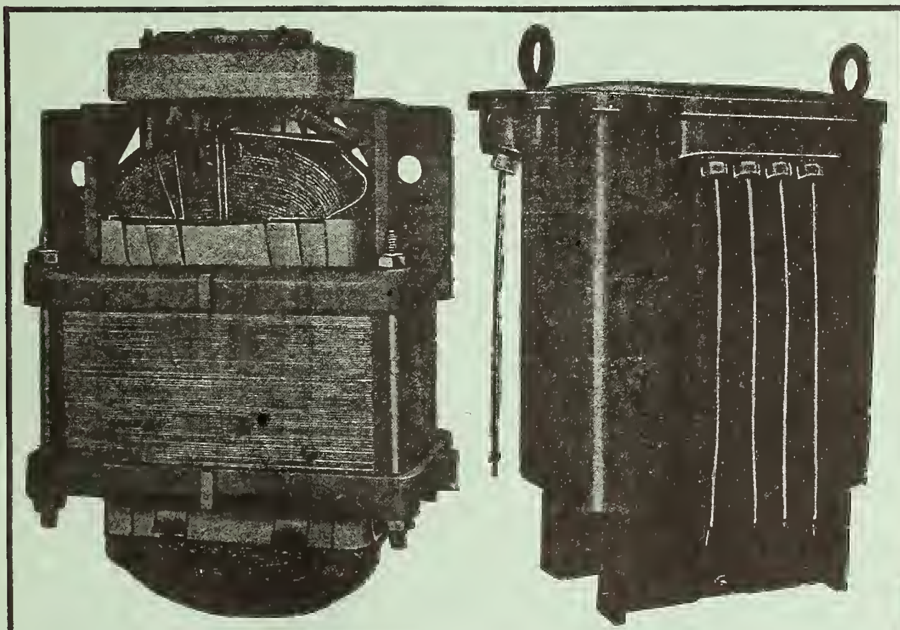

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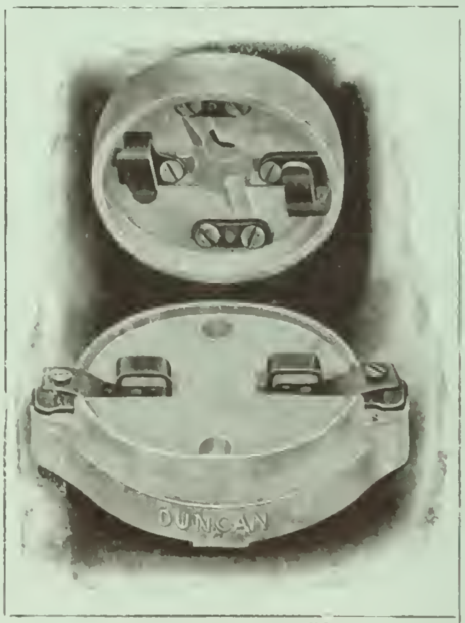

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SPARKS.

The Northern Electric & Manufacturing Company, of Montreal, have established a branch at Winnipeg.

The Alvinston Power Company, of Alvinston, Ont., are extending their plant, and are in the market for a new engine and generator. Mr. H. R. Carruthers is manager.

The Hamilton Anchor Company, Hamilton, Ont., report a steadily increasing demand for their anchors, which are giving general satisfaction. This is strictly a Canadian company and well deserving of the patronage of Canadians.

The suit of Barry & McMordie, contractors, against the Electrical Development Company of Ontario has been settled out of court. The action was for the balance of the contract price for building the company's coffer dam and for extras in the work.

Mr. T. W. Kneeland, of Malone, N. Y., representing the Gaspereaux Power Company, is now building a power house at White Rock Mills, about four miles south of Port Williams, N. S. He has made contracts to light the towns of Wolfville and Kentville.

It is understood that the Minister of Inland Revenue will introduce legislation at the present session of the Dominion Parliament to provide for a Government inspection of meters used in connection with the supply of electricity for power purposes, as is now done in the case of electric light.

The Civic Island Committee of the Toronto City Council recommended that the lighting plant at the Island be dispensed with. The cost last year for 38 lamps was $1,315, whereas the Toronto Electric Light Company agreed to supply the same number of lamps, giving 25 per cent. more light and an all-night service, for $1,104.

The Evans Rotary Engine Company of Canada, Limited, has been granted an Ontario charter, with a capital of $250,000, and head office in Toronto. This company proposes to manufacture the Evans rotary engine. The provisional directors include J. M. Evans, mechanic, Kenneth Rose, consulting engineer, and J. H. Chewett, civil engineer.

SPARKS.

The Northwest Electric Company, Limited, of Calgary and Edmonton, have opened a branch at Medicine Hat, which will be in charge of Mr. R. W. Turner.

Mr. S. Sedziak, member of the International Society of Electrical Engineers, has opened a class in the Y. M. C. A. at Winnipeg for the instruction of electrical engineering students.

The following officers were elected at the annual meeting of the Electrical Construction Company, Limited, of London, Ont.:—President, Dr. J. B. Campbell; Vice-President, Wm. Heaman; Secretary, A. Gorman; Directors, W. H. Wortman and J. A. Thomas. Mr. J. T. Cahill, who has been acting as manager, was permanently appointed to that position.

A special meeting of the directors of the St. Lawrence Power Company was held at Ottawa on February 5th, when the resignations of two directors were accepted, and Mr. George G. Foster, K.C., of Montreal, and Mr. Stevens, of Waterloo, Que., were elected in their places. Subsequently Mr. Foster was elected president, in place of Mr. M. P. Davis, who becomes managing director.

SPARKS.

A number of Montreal and Ottawa gentlemen have had a conference with the Stratford, Ont., Board of Trade with reference to the charters held by the board for electric railways in the district.

The Canada Electric Syndicate, Limited, which will carry on operations on a large scale in Mexico, have engaged Mr. W. F. Tye, C.E., of Montreal, Que., to superintend the engineering work. Mr. Tye left for Mexico on January 14th.

The Winnipeg Street Railway Company has issued orders that smoking is prohibited in any part of the cars, and that passengers will not be allowed in the vestibules so long as there is room in the car.

Another company recently incorporated by the Ontario Government with authority to distribute electricity for light, heat and power purposes is the Iroquois Pipe Line Company, Limited, Chatham, Ont. The capital of the concern is $100,000, and the provisional board of directors consists of H. D. Symmes, contractor; W. E. Woodroof, barrister-at-law, and D. A. Coste, oil merchant.

SPARKS.

The annual report of the Ottawa Electric Railway, which was recently issued, shows the gross earnings for 1906 to be $525,746.09, an increase over the previous year of $76,112.62.

Contracts for the construction of tho dam at Eugenia Falls for the Georgian Bay Power Company have been awarded to the Ambursen Hydraulic Construction Company, of Montreal, tho work to commenco not later than May 1st. The dam will bo about 540 feet long and will hold back approximately 13,000,000 cubic feet of water. The turbines will be capable of developing 1,500 horse-power.

The annual report of the Toronto Electric Light Company for the year ending December 31st, 1906, showed an income of $899,578.56, with expenses (including interest on debentures) of $562,847.64, leaving a balance of profit of $336,730.92, or a little over 11.2 per cent. on the paid-up capital. During the year 62,352 lamps were installed and 2,020 horsepower of motors. With the introduction of Niagara power it is expected this increase will this year be materially exceeded. In moving the adoption of the report the president forecasted a probable reduction in prices for light and power as soon as the new plant is working smoothly.

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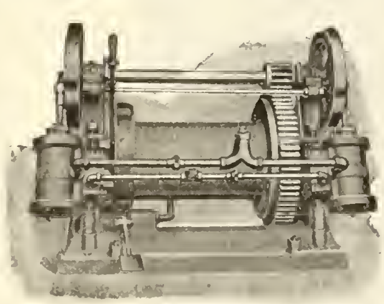

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CANADIAN

ELECTRICAL NEWS

AND

ENGINEERING JOURNAL

Vol. XVII FEBRUARY, 1907 No. 2

THE S. P. S. ELECTRICAL CLUB.

The S.P.S. Electrical Club at the School of Practical Science, Toronto, was organized in December, 1906. Its organization was the result of the general opinion among the senior mechanical and electrical students that there should be a Club of this kind in connection with the Faculty of Applied Science, whereby subjects of direct interest to these students might be discussed. It was also thought that, if such a Club were formed, an opportunity would thereby be provided for practice in speaking and debating.

G. P. Coulter, Third Year Councillor. N. P. F. Death, Fourth Year Councillor. C. H. Hutton, Third Year Councillor.
F. R. Ewart, Vice-President. Wills Maclachlan, President. J. C Armer, Secretary-Treasurer.

EXECUTIVE COMMITTEE OF THE S. P. S. ELECTRICAL CLUB.

An organization meeting was held late in December, at which the following officers were elected: Honorary President, Dr. Galbraith; President, Wills Maclachlan; Vice-President, F. R. Ewart; Secretary-Treasurer, J. C. Armer; Fourth year Councillor, N. P. F. Death; Third year Councillors, G. P. Coulter and C. H. Hutton.

The regular meetings of the Club are held in the evening of every second Thursday. The first three meetings have been very successful, and the prestige the Club has already gained augurs well for the future success of the Club.

Another important object of the Club is to further the knowledge of the members in practical engineering, and to carry out this idea arrangements are made for the members of the Club to visit different power and manufacturing plants in the city and vicinity on Saturday mornings or afternoons. The members have now visited the two generating stations of the Toronto Electric Light Company, the waterworks, and the Davenport transformer station. This has proved a very popular policy, as is evidenced by the large turnout at these visits.

The amount of copper in use on the lines of the American Telephone & Telegraph Company is now in excess of 166,500 tons.

ARMATURE REACTION IN POLYPHASE ALTERNATORS*

By L. A. Herdt, McGill University, Montreal.

In a paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers in 1902 the writer advocated a method for the predetermination of alternator regulation based upon the principles laid down by Blondel[1] that, when an alternator supplies a current dephased by an angle ϕ with respect to the internal induced electromotive force, the armature reaction may be considered as the result of a direct reaction produced by the wattless component of the current (I sin ϕ), and a transverse reaction due to the watt component of the current (I cos ϕ).

The object in writing another paper on the same subject is to outline an experimental method for the determination of the regulation of alternators under load, based on the above theory.

THEORY OF ARMATURE REACTION.

In a distributed armature winding type of alternator when the field magnets are excited, the field magnetomotive force will set up in the air-gap a certain induction distribution. This distribution is approximately sine form, but depends of course on the shape of the pole-pieces and the saturation of the magnetic circuit. The flux set up by the field magnetomotive force revolves with the field structure and its distribution remains practically undisturbed throughout one revolution, as with a distributed armature winding the reluctance of the magnetic circuit for any particular position of the field structure is practically the same.

With respect to the stationary armature windings the field flux corresponds to an alternating flux, cutting through the armature coils, increasing and decreasing according to a sine law. The field flux, and the field magnetomotive force as well, can be represented in direction and magnitude by a vector of constant length revolving at the speed of the field structure in revolving field alternators, or fixed in space in revolving armature alternators.

When the armature carries a current, the armature magnetomotive force set up by three-phase currents in the windings is also an alternating function whose form depends upon the type of winding, but in the ordinary type of alternators it does not differ very much from the sine curve. The armature magnetomotive force can therefore also be represented by a vector revolving at the speed of the field structure; the dimension of this vector depends on the strength of the armature current, and the position it occupies relatively to the field magnetomotive force vector depends on the phase angle between the induced electromotive force and the current. With inphase current the armature magnetomotive force rotates ninety degrees behind the field magnetomotive force; that is, in quadrature with it. When the current lags ninety degrees behind the induced electromotive force, the armature vector is at 180 degrees to the field magnetomotive force; that is, in line with it but opposed to it. For other phase displacements between the current and the volts the armature lags or leads the field magnetomotive force by an angle of ninety degrees plus the angle between the current and the induced electromotive force.

[1] "The Empirical Theory of Alternators," A. Blondel, L'Industrie Electrique, 1899.

*Reprinted from the Electrical Review, New York.

Under load these two distinct magnetomotive forces, namely, the field and the armature magnetomotive forces, will set up the resultant induction distribution. The regulation of the alternator evidently depends on the change between the no-load induction and the induction set up under load. Thn change from the no-load induction due to a certain value of the armature magnetomotive force will vary with the power-factor, that is, the induction set up by the armature magnetomotive force varies not only with the magnitude of the magnetomotive force but also with the position this magnetomotive force wave occupies relatively to the field-poles.

While in induction motors, for example, the distribution of magnetic induction in the air-gap can be taken directly from the distribution of the magnetomotive force, for the gap length is constant, this will not apply, even to an unsaturated alternator, for the induction set up by the armature magnetomotive force will invariably depend upon the relative position of the armature magnetomotive force wave and the field structure.

ARMATURE REACTION WITH INPHASE CURRENT.

In Fig 1 is shown the arrangement of the armature coils of a three-phase alternator (two slots per pole per phase).

Curve I is the field magnetomotive force. The armature magnetomotive force produced by three-phase currents assumed of sine form in phases I, II and III for the particular instant stated in the figure and for current assumed inphase with the induced electromotive force, is shown by the right-angled Curve II, which can be assumed smoothed out to approximate a sine curve.

At ay other instant (see Figs. 2, 3 and 4), this armature magnetomotive force changes but little and the position it occupies relatively to the pole-pieces remains unchanged, assuming, of course, that the angle between the volts and the current is not altered.

The induction set up in the air-gap at no-load by the field magnetomotive force (Curve I Fig. 1) is given by Curve III. This flux is calculated by taking at every point the value of the magnetomotive force acting and the relutance is assumed as that equivalent to the air-gap alone. (Experiments that have been carried out on this machine, and which are discussed further on, show that the flux calculated in this way comes very close to the actual distribution determined experimentally.) The flux set up by the armature magnetomotive force is shown by Curve V. (The lines across the slots and those which interlink with the end connections are neglected for the present.)

Curve IV is the resultant induction distribution due to the magnetomotive forces I and II. From this figure it is shown that the armature magnetomotive force with inphase current sets up a cross flux increasing the induction in one side of the pole-pieces and diminishing the induction in the other. A change in the distribution of magnetic flux is thus set up by the armature magnetomotive force, but the resultant total induction is but slightly altered. This is specially

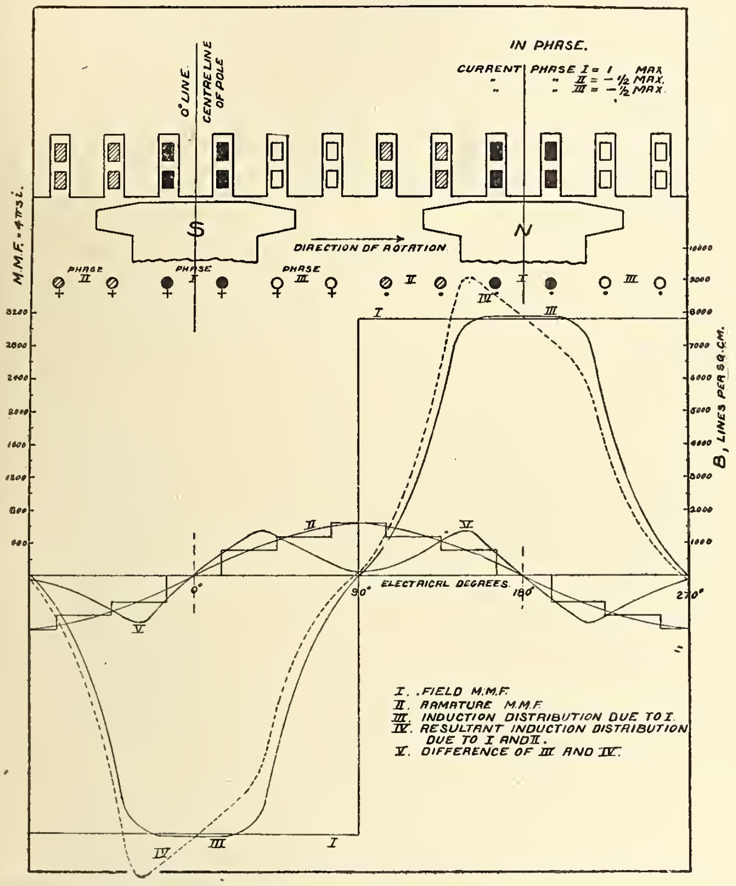


Fig. 1—Arrangement of Armature Coils of a Three-Phase Alternator, also Distribution of Field and Armature Magnetomotive Forces for Particular Position of Field-Poles at a Particular Instant. Inphase Current.

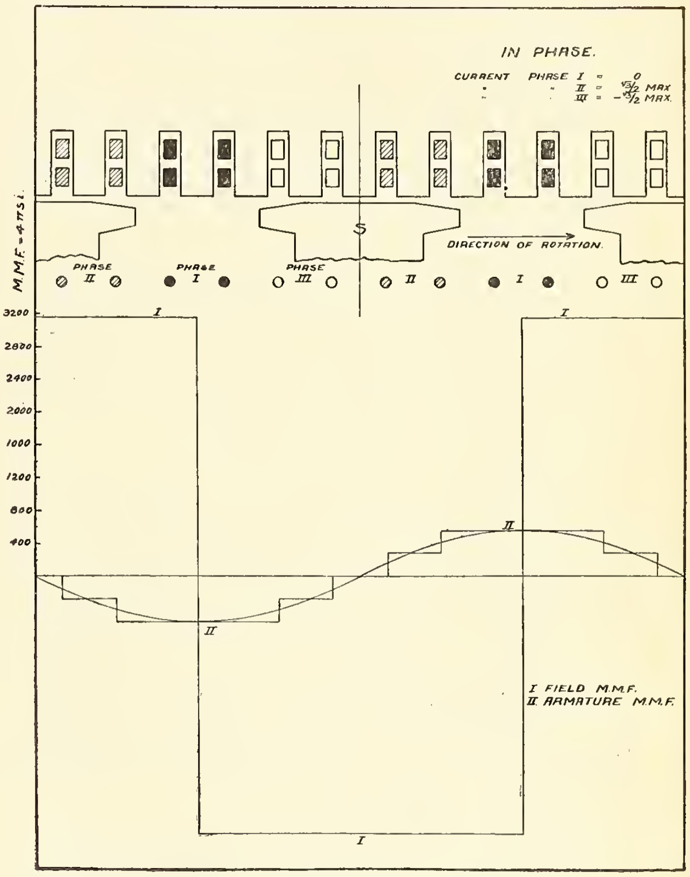


Fig. 2—Showing Relative Position of Field-Poles and Armature Magnetomotive Force at Another Instant, Inphase Current.

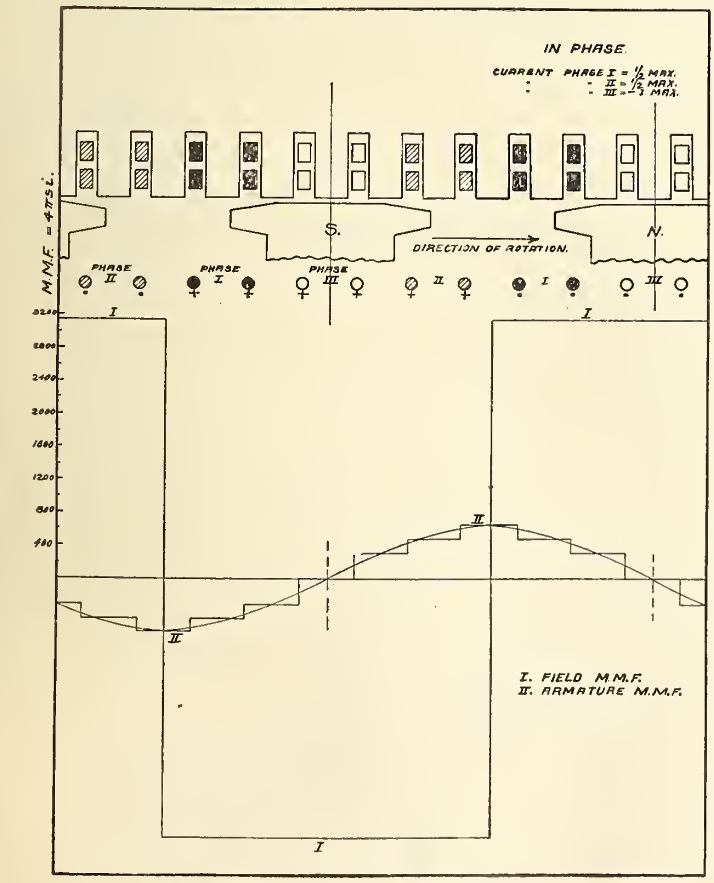


Fig. 3—Relative Position at Another Instant. Inphase Current.

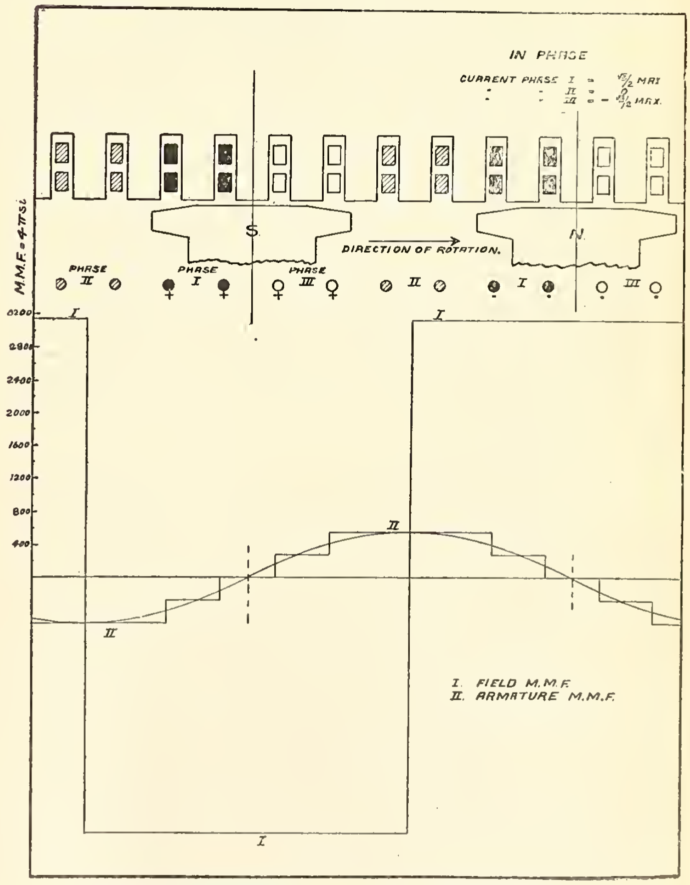


Fig. 4—Relative Position at Later Instant. Inphase Current.

so with alternators having chamfered pole-pieces, as with inphase current the armature magnetomotive force wave, having its maximum ordinates between the poles, can not set up any marked effect of armature reaction, the reluctance being considerable.

EFFECT OF LAGGING CURRENT UPON ARMATURE REACTION.

In Fig. 5 the same method is applied to determine the distribution of armature magnetomotive force when the current is lagging ninety electrical degrees behind the electromotive force.

The distribution of magnetomotive force is the same as that for inphase currents (see curve II, Fig. 1). The magnetomotive-force wave, however, is displaced by ninety degrees from the position it held for similar values of inphase current. This rotating magnetomotive-force wave is now at 180 degrees to the field magnetomotive force and opposes it.

The induction set up by the armature magnetomotive force with quadrature current is vastly different from that set up by inphase current, although the magnetomotive force values are unchanged for equal currents The reluctance of the magnetic circuit is entirely different from that of the inphase current ; in this case the maximum ordinates of the armature magnetomotive-force wave act over the pole centres and the armature magnetomotive force is now directly opposed to the magnetomotive force ; the reluctance of the magnetic circuit is that of the machine.

It is thus shown that the induction set up by an armature magnetomotive force with quadrature currents is greater than that set up by an equal amount of inphase current, also that the effect of the armature current in diminishing the no-load induction and varying its distribution depends on the phase relation of the electromotive force and current.

ARMATURE REACTION FOR NON-INDUCTIVE LOAD AND INDUCTIVE LOAD THEORETICALLY AND EXPERIMENTALLY DETERMINED.

The effect of the armature magnetomotive force on the no-load induction distribution has also been worked out (1, for non-inductive load, Fig. 6 ; 2, for an inductive load of power-factor sixty-two per cent., Fig. 7).

In the first case the current lags behind the total induced electromotive force by twelve degrees, in the second case the current lags fifty-two degrees. The different effects of the armature reaction for these two particular loads, the magnetomotive forces being equal, are shown by curve V on both figures. The effect of the lagging current in diminishing the total induction is well marked.

As previously stated, these curves are all calculated curves. Experiments were carried out to obtain these curves experimentally and to compare them with the calculated curves.

In Fig. 8 is shown the no load induction distribution for a certain value of the field magnetomotive force.

Curve I is the calculated or predetermined curve used before. Curve II is the same curve obtained experimentally. The induction distribution with non-inductive load experimentally determined and calculated is shown in Fig. 9, and for inductive load fifty-two degrees lag in Fig. 10. These curves show that the effects of armature reaction can be calculated very closely.

ARMATURE REACTION.

The above discussion shows that armature reaction, including the cross-magnetizing effect, the demagnetizing effect, and the armature leakage, can not be expressed as an equivalent reactance, irrespectively of the lag or lead of the armature current. Any method to predetermine correctly the regulation of an alternator that does not take into account these separate effects of the armature magnetomotive force must be incorrect.

When the armature current lags behind the nominal induced electromotive force by an angle between zero and ninety degrees we may regard the armature magnetomotive force as made up of two components, a quadrature component and an inphase component.

DIRECT REACTION.

The quadrature component of the magnetomotive-force wave has its maximum ordinates over the pole centres and sets up the demagnetizing effect. This can be expressed either in ampere-turns and the demagnetizing effect measured off as KNI sin ϕ, ϕ being the phase angle between the current and the volts, or as an equivalent reactance X_1 and this multiplied by I sin ϕ, the quadrature current (I sin ϕ X_1), will give the demagnetizing effect. The value of X_1 can be experimentally determined, as will be shown presently.

TRANSVERSE REACTION.

The inphase component of the magnetomotive-force wave has its maximum ordinates midway between the pole centres and sets up the cross-magnetizing effect. This is equal to a constant X_2 , and this multiplied by I cos ϕ the inphase current (I cos ϕ X_2) expresses the cross-magnetizing effect due to the inphase current. The value of X_2 can also be experimentally determined.

LEAKAGE REACTANCE.

The leakage flux encircling the armature conductors is entirely independent of the lag or lead of the current, but as it varies directly with the current it can be expressed in the form of IX_3, X_3 being an equivalent reactance.

EXPERIMENTAL DETERMINATION OF X_1, X_2 AND X_3.

Demagnetizing Component of Armature Reactance (X_1)—X_1 can be determined experimentally by working the alternator on a purely reactive load so that the demagnetizing effects of varying quadrature armature current with full field excitation are determined. It is advisable as stated to determine these effects with full field excitation and not an excitation just sufficient to circulate full-load current through the armature short-circuted as is ordinarily done. X_1 is essentially variable for different armature current intensities on account of the saturation of the iron.

Cross-Magnetizing Effect of Armature Reaction (X_2)—X_2 can not be taken at a value equal to the synchronous reactance X_1 obtained in the test with quadrature current. It is, however, proportional to X_1 ; that is,

$$\frac{X_2}{X_1} = \frac{\text{reluctance of magnetic circuit poles placed as shown in Fig. 11.}}{\text{reluctance of magnetic circuit poles placed as shown in Fig. 12.}}$$

Knowing X_1, the ratio of these two reluctances is all that is required. This value is determined experimentally as follows : A search coil of width equal to the pole pitch and encircling the armature is placed in the air-gap and connected to a galvanometer or volt-

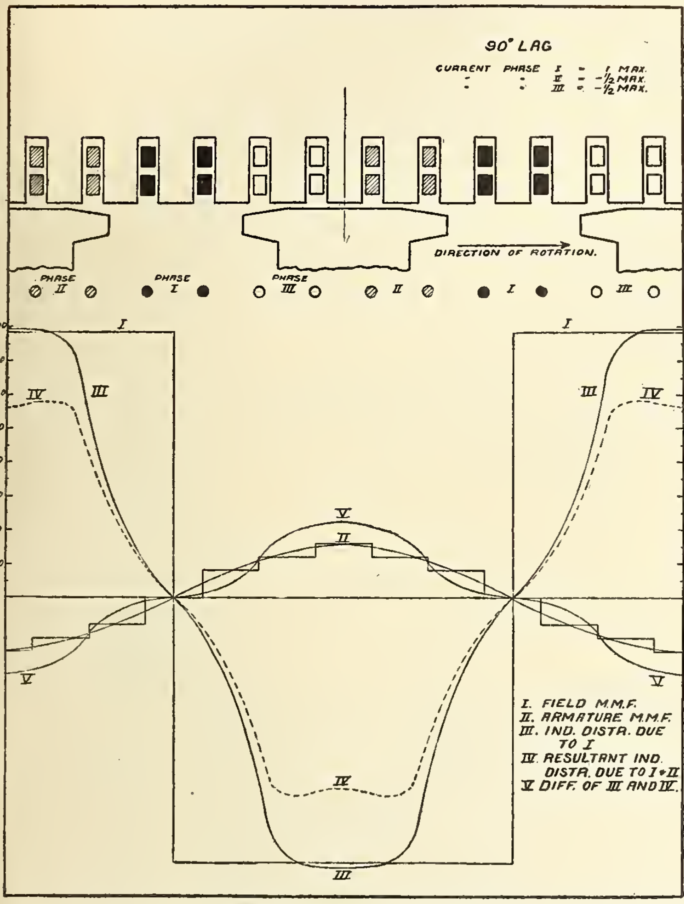


FIG. 5.—DISTRIBUTION OF ARMATURE MAGNETOMOTIVE FORCE, WITH CURRENT LAGGING NINETY ELECTRICAL DEGREES BEHIND ELECTROMOTIVE FORCE, AND RESULTANT INDUCTION DISTRIBUTION.

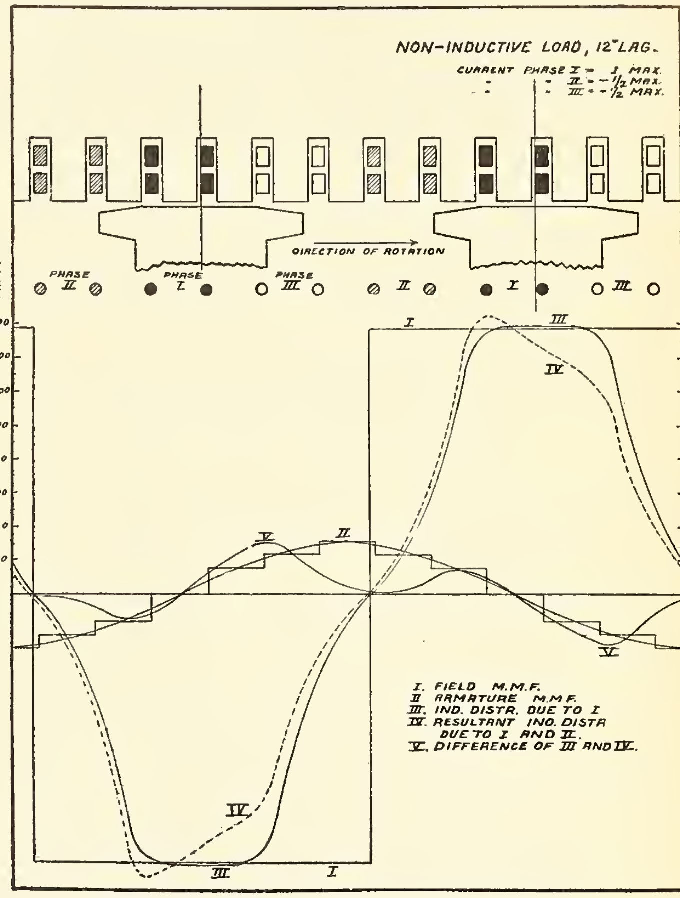


FIG. 6.—ARMATURE MAGNETOMOTINE FORCE FOR NON-INDUCTIVE LOAD, AND RESULTANT INDUCTION DISTRIBUTION.

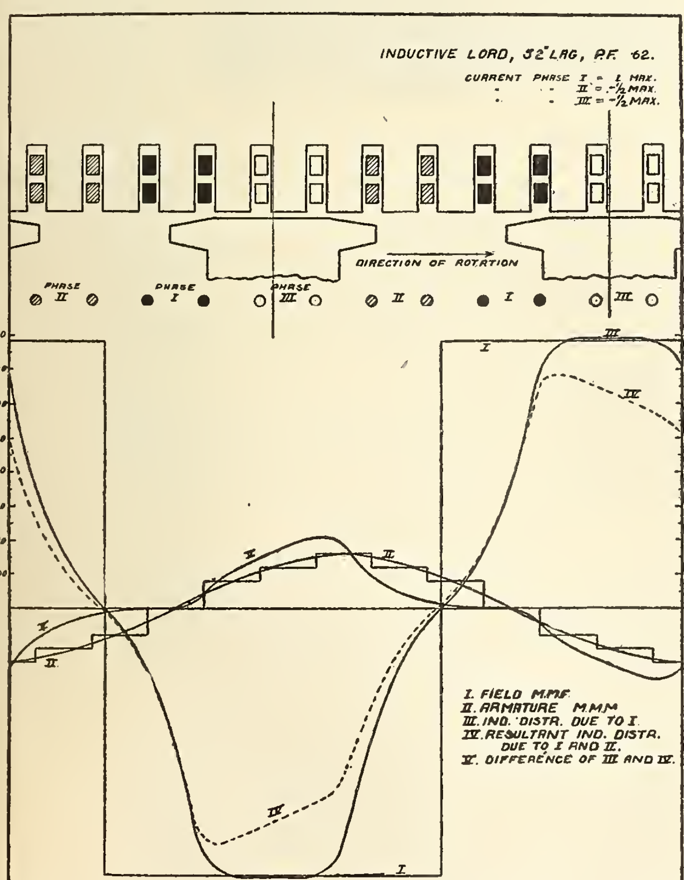


FIG. 7.—ARMATURE MAGNETOMOTIVE FORCE FOR INDUCTIVE LOAD OF POWER-FACTOR 0.62, AND RESULTANT INDUCTION DISTRIBUTION.

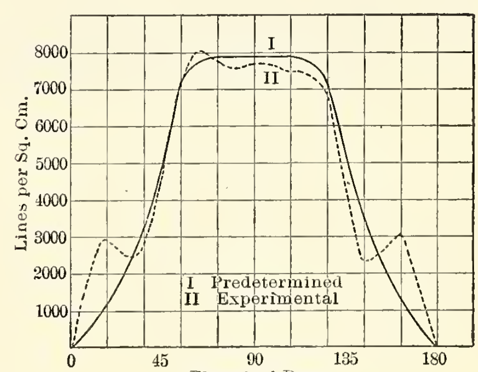


FIG. 8.—NO-LOAD INDUCTION DISTRIBUTION.

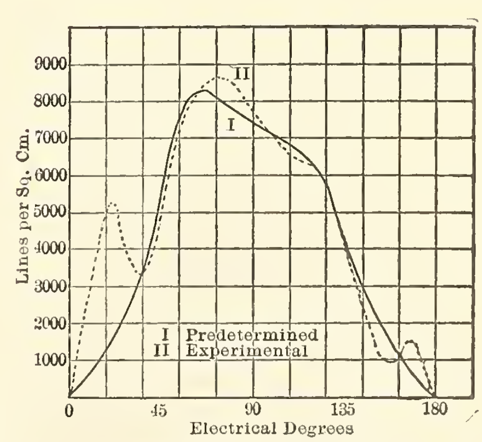


FIG. 9.—NON-INDUCTIVE LOAD INDUCTION DISTRIBUTION. TWELVE DEGREES LAG.

meter ; the fields are excited. A direct current equal to I maximum value is passed in phase I, and half maximum values in phases II and III ; the poles are placed first in position, relatively to the search coil, as shown in Fig. 11, the armature current is reversed or broken, the poles are then placed in position relatively to search coil as shown in Fig. 12 and the armature current again broken or reversed. The ratio of the deflections of the galvanometer or voltmeter is the ratio referred to above. X_2 is thus obtained.

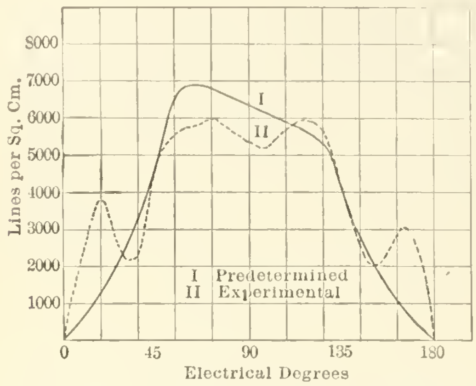
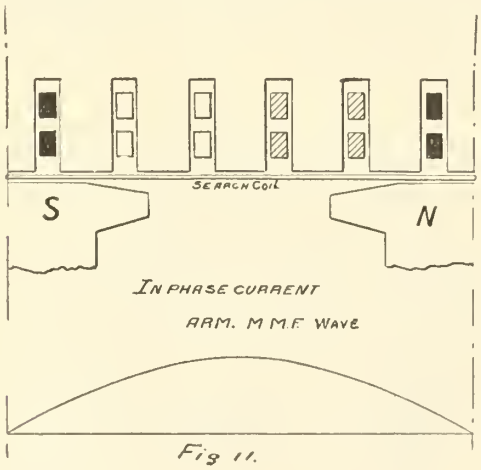
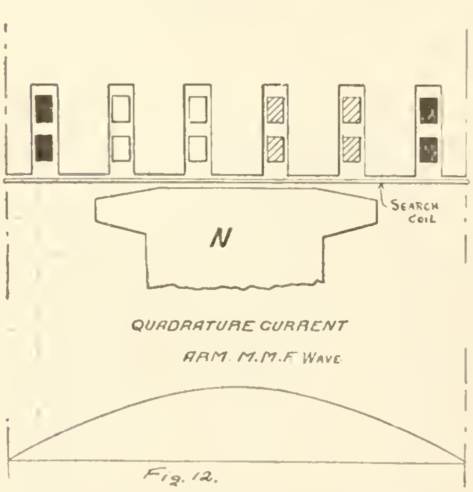


Fig. 10.—Inductive Load Induction Distribution Fifty-two Degrees Lag. Power Factor 0.62.

Armature Leakage Flux (X_3)—This flux can be determined theoretically but with difficulty. Experimentally it can be determined by measuring the reactance per phase of alternator with field magnets removed.

The reactance X_3 obtained in this way multiplied by the armature current I gives the value of the electromotive force of self-induction set up (IX_3). The electromotive force acts in quadrature with the current.





Figs. 11 and 12.—Search Coil Test for Obtaining Ratio of the Reluctance of the Magnetic Circuit for the Two Particular Positions of Field Structure Shown.

ALTERNATOR DIAGRAM.

Using the values so obtained for the demagnetizing and cross-magnetizing components of synchronous reactance, and for armature leakage reactance, the following diagram properly expresses the relation of electromotive forces and current in the armature of an alternator under load.

The line ON represents in direction and magnitude the field flux ; this field flux sets up to total induced electromotive force (E_o) ; that is, the no-load electromotive force.

r_a = resistance of armature.

X_3 = reactance due to leakage flux alone.

Ir_a = the electromotive force of resistance drop set off on the current line.

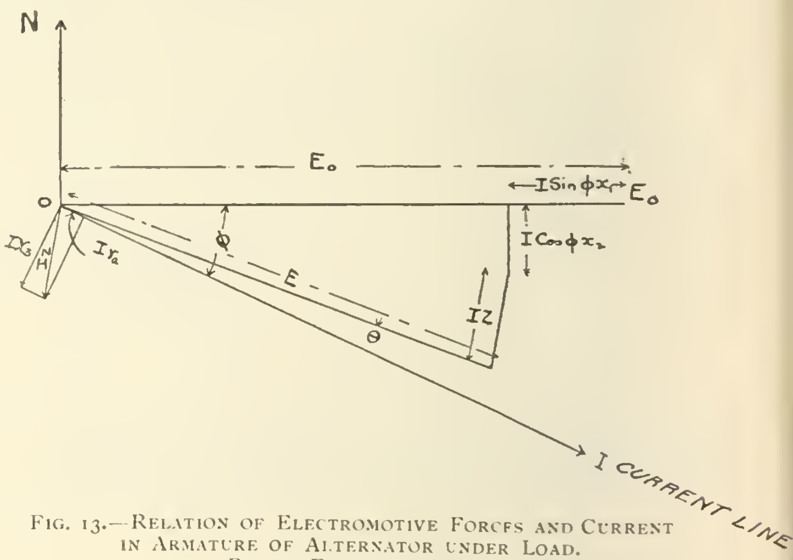


Fig. 13.—Relation of Electromotive Forces and Current in Armature of Alternator under Load. Power Factor = cos O.

IX_3 = the electromotive force set off at right angles to the current.

IZ = drop due to leakage reactance and armature resistance.

I sin ϕ X_1 = drop of potential due to the demagnetizing effect of the quadrature armature current that is set along E_o line and opposing it.

I cos ϕ X_2 = the electromotive force set up by the cross-magnetizing effect of the inphase armature current ; this is set off at right angles to E_o.

Combining all these electromotive forces, the terminal voltage E is obtained.

This method, applied to a number of alternators, has been found to give very accurate results. The application of this method to a number of alternators will be discussed in a paper to appear shortly.

Engines are now being used on the Canadian Pacific railway in which great economy in coal is effected by superheating the steam used. Simple engines with the superheater are doing the same work as compound engines without superheat, and in the best instanced with three-fourths of the coal consumption.

Incandescent Lamps.—Herr Teichmuller collects the following as being the consumption of electrical energy by the different electrical incandescent lamps now in current use : Carbon filaments 3.2 and 3.5 watts per Hefner candle (equal 3.65 to 3.9 watts per British standard candle); tantalum lamps, 1.76; osmium lamp, 1.5; zirconium-carbon, 2.44; zirconium lamp, 1; and the new "metal-filament" may possibly bring this down to 0.5.—The Gas World.

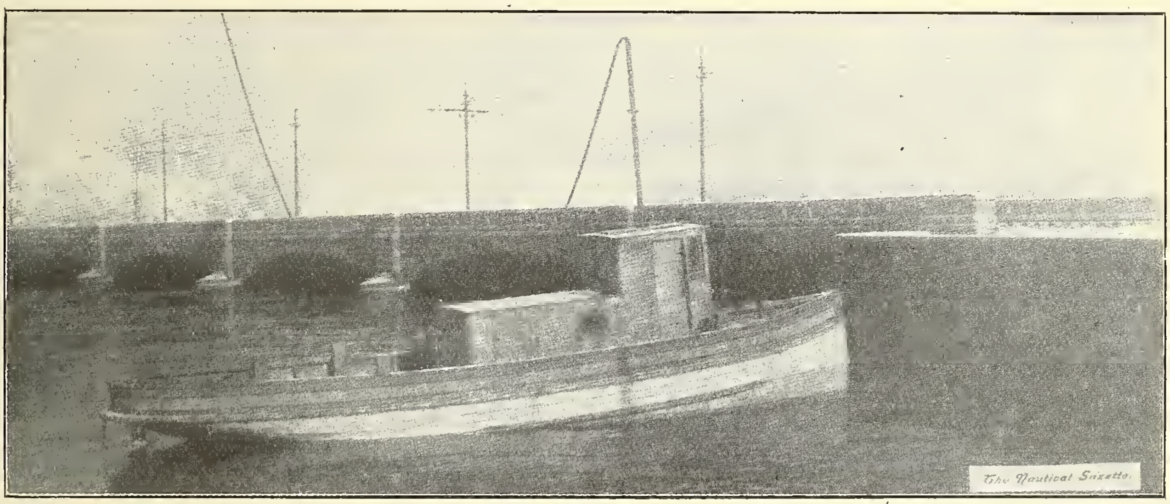
A TROLLEY PROPELLED TUGBOAT.

One of the most interesting vessels in America is a small tugboat belonging to the Canadian Niagara Power Company, of Niagara Falls, Canada, which is operated by electricity, secured through an overhead wire, the electric current being secured in the manner of street railway trolley cars.

The hull is of wood, 40 ft. long, 10 ft. beam, 6 ft. draught. The propeller is of steel, 5 ft. in diameter, attached to a propeller shaft 6 in. in diameter, the propeller being fitted to shaft with taper fit and feather key secured with brass nut. The electrical equipment consists of a 125 k. w. air blast transformer with ratio of reduction 1,100 volts to 220 volts. There are several low voltage taps on the transformer which are used for bringing the motors up to speed or for running at a reduced speed. There are two motors, known as Westinghouse No. 106 alternating current design to develop 75 h.p. each at a speed of 1,050 revolutions. The motors are geared to the extension of propeller shaft through pinions and gears having a ratio of 16 to 66, thus at full load the motors will develop 150 h.p. at about 1,000 revolutions of armature or 240 revolutions of the propeller shaft. The motors and transformer, which are located on the boat, are arranged to be cooled with forced draught supplied by a 1 h.p. alternating current motor direct connected to a blower. Air pipes with suitable dampers for properly distributing the air flow lead from the blower to the motor and transformer cases. In this manner cold air is forced through the portion of the motors and transformer near the windings. This is especially necessary in a boat equipment, as the hull of a boat offers very little opportunity for radiation necessary in all self-cooled electrical apparatus. The trolley structure consists of two No. 2/0 trolley wires supported parellel to each other and 2 ft. apart at a distance of 60 ft. above the water. The trolley wire extends the entire length of the forebay, a distance of about 600 ft. These trolley wires are secured through strain insulators, and current at a voltage of 1,100 volts is conducted to them by duplex No. 3/0 lead sheathed cable which is brought up to the trolley wires alongside of one of the guy rods of the trolley poles.

Power for operating the boat is supplied from the main switchboard at 11,000 volts, and is stepped down through a 125 k. w. water-cooled transformer having a ratio of 11,000 to 1,000 volts. Suitable meters, switches, circuit breakers, etc., are installed in the 1,100-volt circuit for the purpose of controlling the current and measuring the power used by the equipment.

The hull of the boat was constructed by Benjamin L. Cowles, of Buffalo, N. Y. The electrical equipment was built by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, and the Canadian Westinghouse Company, of Hamilton, Ontario. The installation of the machinery in the boat and the construction of the overhead trolley equipment was carried out by the Canadian Niagara Power Company's engineers.—The Nautical Gazette.



Tugboat Equipped with Electric Motors Receiving Power from Overhead Trolley Wires.

INSPECTION TRIP OF McGILL ELECTRICAL STUDENTS.

Perhaps never before have the electrical students of McGill University had so favorable an opportunity of visiting a number of interesting plants as that which was afforded by the recent trip to Niagara Falls. About thirty of the electrical engineering graduating class, accompanied by Dr. R. B. Owens and Professor L. A. Herdt, left Montreal on the evening train on Thursday, February 14th, reaching Hamilton early Friday morning. Here they became the guests of the Canadian Westinghouse Company, and spent a portion of the day in inspecting the magnificent works of that company. Later they went to DeCew Falls to visit the power house of the Hamilton Cataract Power, Light & Traction Company, being accompanied on this trip by Mr. William Kennedy, hydraulic engineer, of Montreal. They then proceeded to St. Catharines as the guests of the Packard Electric Company, whose works were inspected with a great deal of interest. Saturday and Sunday were spent at Niagara Falls, where the gigantic power plants of the Canadian Niagara Power Company, Electrical Development Company and Ontario Power Company were thrown wide open and every opportunity afforded to secure information and instruction regarding the design, construction and operation of these plants. The headquarters of the party were at the Clifton House. The faculty and students are loud in their praise of the hospitality extended to them by the different companies, and the trip from beginning to end was of the most enjoyable nature.

The party returned to Montreal Sunday night.

A 10,500-Horse Power Hydraulic Turbine with Volute Casing

By W. M. White.

Turbine water wheel construction in this country is entering upon an entirely new phase. The typical American turbine is an article of manufacture made from a set of patterns of definite sizes and listed for sale like high-speed engines. The design of these wheels, while involving theoretical analysis, has been largely the outgrowth of experiments conducted at the Holyoke testing flume the wheels being tested and modified in accordance with the results and new sizes being designed on the lines of those previously built and then re-tested. The purchaser of these wheels ordinarily selects one from the list which will give the required power and connects it to the machinery to be driven by gearing which will change its speed under the given head to that required for the driven machinery.

The results of this process of development have been remarkable. Not only have the efficiencies been exceptionally high, but the reduction of the wheels to the manufacturing basis has resulted in a cost which has made the American turbine a machine of a combined cheapness and efficiency which is unmatched elsewhere.

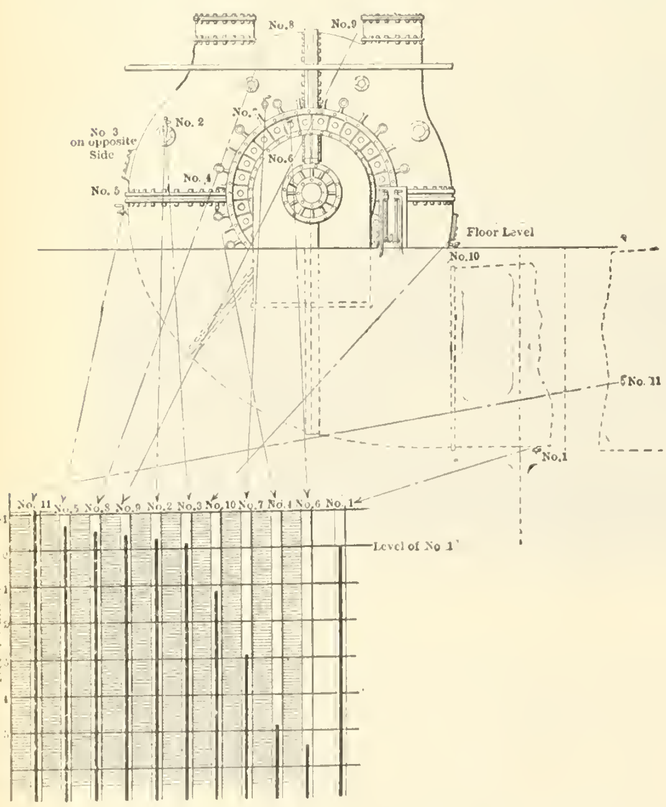


Fig. 2. -Test-Pressure Connections and Readings.

NEW CONDITIONS IN THE TURBINE INDUSTRY.

New conditions are, however, now entering the development of water powers in this country to which this system of design and construction is not applicable The desirability of connecting the wheel and the generator to the same shaft in electric generating stations makes it necessary that the speed of the wheel shall be pre-determined, while the speed of a stock design of wheel is exactly the thing which is beyond control, and it hence becomes necessary to design wheels for such plants to suit the conditions, in which the power, speed and efficiency are fixed in advance. These new conditions obviously make it impossible to make use of the experimental development method, each wheel being designed for its location and under a guarantee of performance. Moreover, the power now required in single units is far beyond the reach of listed wheels and the necessity for better governing than has heretofore prevailed has added another to the many problems of the hydraulic engineer. The first important case of this kind to be met in this country was the original Niagara Falls plant and others are constantly coming to the front.

It is true that the older designs of wheels have, in osme cases, been applied to direct-connected generating stations, but this is only occasionally feasible. By accident it may happen that a stock wheel or a modification of it will give the required speed and power under the given head and in other cases the generator may be specially designed to suit the speed of the wheel, but such a method is obviously of limited application. The great development of the Pelton and other impulse wheels for this class of work is largely due to their flexibility of design as regards speed. The peripheral speed of the buckets being fixed by the head, the required rotative speed can be obtained by suitable selection of the diameter, and, within wide ranges of power and head, the adaptation of these wheels to the conditions may be so made as to leave nothing to be desired.

A WHEEL DESIGNED FOR MODERN CONDITIONS.

In the great development of water powers through the utilization of electricity there are, however, many cases which must be attacked as original problems in every feature, and in such cases a special design of wheel is a necessity. This article relates to such a wheel, which was required to develop 10,500 horse-power at a speed of 180 revolutions per minute and under a head of 135 feet with a guaranteed efficiency of 78 per cent. This turbine was recently designed, built and installed by the I. P. Morris Company, of Philadelphia, for the Shawinigan Water & Power Company, of Shawinigan Falls, P. Q. The design is unusual in the size of the wheel, in the use of the volute type of casing and in the control of the gates both by hand and by the governor.

The general design of the wheel was the outgrowth of the desire of the engineers to have the supply pipe below and the generator above the floor level, which comes just below the hand-hole shown on the left-hand side of the casing. The volute casing is the result of my conviction that it would give a better efficiency than any other type, because of the uniform velocity of the water as it passes around the distributors into the vanes, by which shocks are avoided and the full available head utilized. The European practice is to make the volute of such size that the water enters at high velocity, which of course, reduces the size of the casing for a given output.

MEANS ADOPTED TO SECURE HIGH EFFICIENCY AND RESULTS.

Believing that the prevailing velocities of 16, 18 and 20 feet per second at the entrance to the wheel were entirely too high, leading to a loss of head due

to the centrifugal force of the water passing around the casing, the velocity was reduced to 8.95 feet, which, of course, added largely to the size and cost of the casing; but the specifications being worded to provide a bonus for each per cent. by which the efficiency exceeded 78 when working at 9,000 horsepower—the full load of the generator—it was believed that the increased cost would be recovered in the bonus, and, moreover, the company desired to produce a wheel which would reflect credit on it as a builder of high-class turbine machinery. The outcome was entirely satisfactory, the efficiencies obtained under a test at which both builders and purchasers were represented by experts being as follows:—

H.-P.	Load Percentage.	Per Cent. Efficiency.
11,270	7.3 per cent. overload	84.7
10,500	Rated load	86.25
8,735	92.7 per cent. load	87.3
9,000	85.7 per cent. load	86.5
7,500	71.4 per cent. load	84.5
6,000	57.1 per cent. load	83.
3,000	28.5 per cent. load	73.5

creased to, say, 18 or 20 feet per second, the differences as shown by the gages of Fig. 3 would be multiplied by about four, so that under the conditions of higher velocity the pressure within the wheel case, near the tips of the vanes, would be four to five feet less than it would be on the outer circumference, and this loss of head would be quite a percentage of the total head operating on the wheel. This head is not, however, all lost, as part of it is accounted for in the velocity of the water as it enters the runner, but the other part of it, due to the impinging action of the water in turning through the volute casing, is lost.

The wheel gates were also made unusually large in order to get full pressure at the vanes, the bonus clause being relied upon to recoup this expense also.

The draft tubes from the wheel were designed so that the velocity of the water as it comes from the runner is decreased gradually until it is discharged into the tail-race. The velocity from the wheel and around the quarter turn is about 18 feet per second,

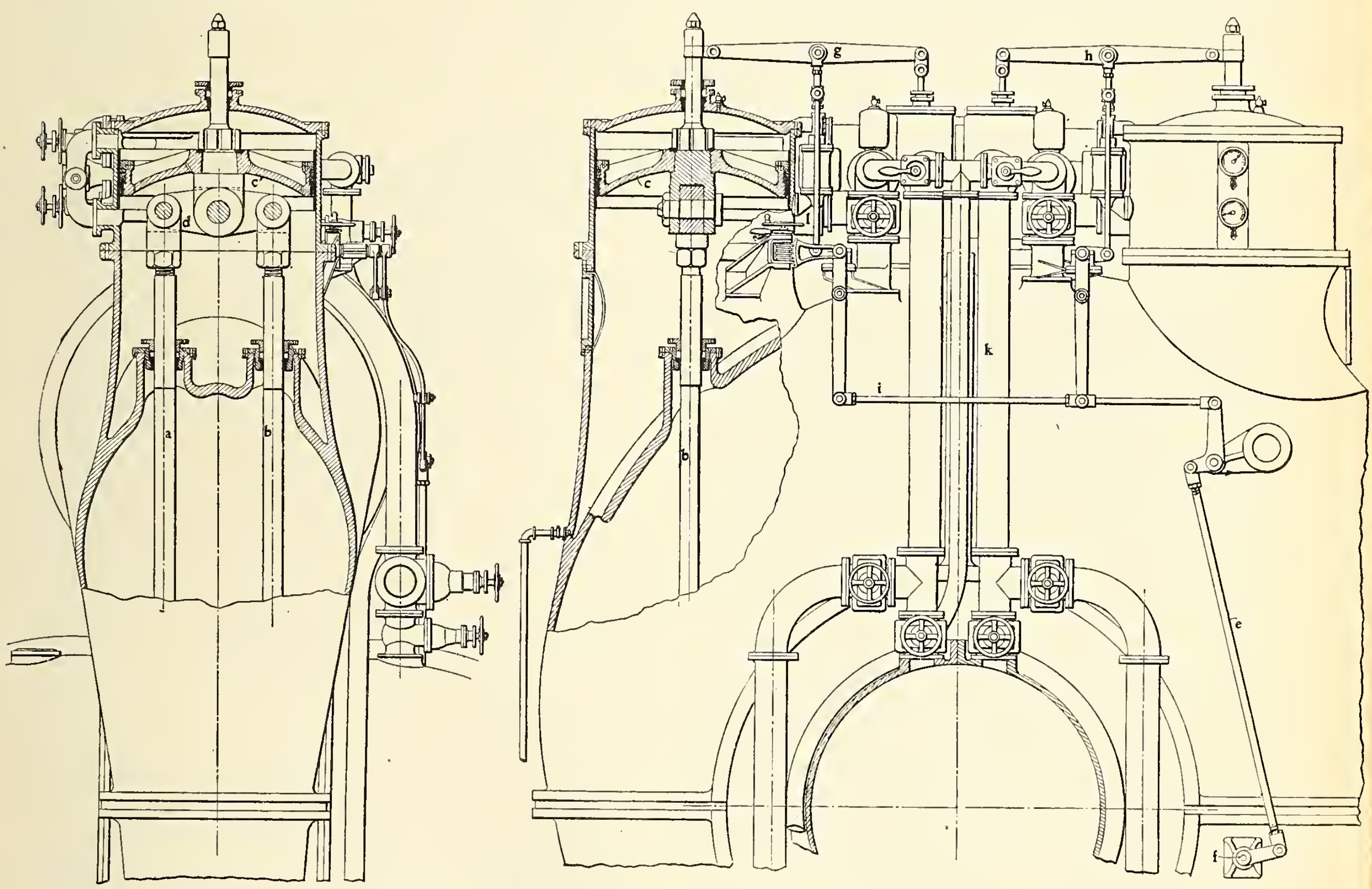


Fig. 3.—Hydraulic Gate Control.

The effect of the centrifugal force of the water in the casing is shown graphically in Fig. 2, which gives the results of pressure-gage readings in various parts of the casing referred to the pressure at the entrance to the casing at zero. When these observations were taken, the wheel was developing 11,000 horse-power. It will be observed that, with the exception of location No. 10, the readings at and near the outer diameter are markedly more than near the inner diameter. The effect is not, however, entirely due to the centrifugal force, but partly to the increased velocity of the water as it enters the wheel, and to its change of direction, which requires force, leading to increased pressure on the outer surface.

As the pressure and difference of head vary as the square of the velocity, it is readily seen that should the velocity at the entrance to the wheel-case be in-

while the velocity at the end of the draft tube as it enters the tail-race is about 3½ feet per second, the draft tubes being gradually enlarged to 10 feet diameter at the ends in the tail-race. The head due to the velocity of the flowing water as it reaches the runners is about 4½ feet. The draft tube was made a part of the turbine wheel and some of this 4½ feet of head was regained by delivering the water in the tail-race at a velocity of 3½ feet per second, with a corresponding velocity head of less than ½ foot. The amount of head regained by the draft tubes would, theoretically, be the difference between the 4 feet and ½ foot, or 3½ feet. The efficiency of the draft tube is, however, only 50 to 80 per cent., so that the actual head regained is about 2 feet, and the efficiency is increased by the ratio of 2 feet to 135 feet, or 1½ per cent.

The diameter of the wheel-case at the entrance flange is 10½ feet. The volute casing is divided into five sections for shipping as well as casting reasons. All the pieces were made in loam from skeleton patterns.

DEFLECTION OF THE SHAFT.

The runner and shaft weigh approximately 20,000 pounds. The runner is of bronze cast in one piece. The shaft is of open-hearth forged steel with a coupling forged in one end. It is 16 inches in diameter through the large bearing, tapering up in the centre of the wheel to 22 inches in diameter, and tapering down at the small end to 10 inches in diameter. The distance between the bearings is 27 feet. This is an unusual length, requiring a stout shaft in the centre to carry the weight.

The deflection of the shaft was calculated to be ⅛ inch, and after it had been completed and the wheel placed on it the actual deflection was carefully measured by means of a surveyor's level and found to be just the amount calculated. To provide for the deflection and to bring the wheel in the centre of the casing the outer or tail-end bearing was raised ¼ inch, the main or generator-end bearing being on the level of the centre of the bore of the casing, the object being to have the shaft horizontal at the generator end bearing and thus bring the joint of the coupling vertical and so avoid strain on it due to the sag of the shaft.

To provide for the resulting inclined location of the wheel runner, the top of the casing was tilted slightly toward the generator, thus bringing the plane of the casing into coincidence with the plane of the runner. The elevation of the tail-end bearing introduced a slight end thrust, but this is negligible in comparison with the thrust introduced by the unbalanced condition of the water. To take care of this thrust, bearings with lignum vitæ books were provided within the draft tubes and for them water is the only lubricant provided.

It is believed by many, though without reason, that under the conditions described the centre of such a shaft will rise to true alinement when at high speed, an idea that is disproved, if it needs to be disproved, by this wheel. The clearance between the runner and the bore of the casing is 1-16 inch only, and there is no evidence that the runner has touched the casing at any point.

GATE OPERATING MECHANISM.

The gates are of the shutter or window-blind type. There are 24 of them, each 24 inches wide. Forged steel links at each side connect the vanes to a pair of steel rings which, by the rods *a b*, Fig 3, are connected to 48-inch operating pistons, of which one is shown at *c*, by means of equalizing levers *d*, by which the same strain is brought on both rings, and the rings and pistons are prevented from canting. The pistons and their attached mechanisms are in duplicate and may be used conjointly or separately, as the pistons have individually sufficient power to operate the gates. The operation of the gates by one piston necessitates that it be double acting, and this construction is employed Water being incompressible, the large clearance space below the pistons does not lead to any loss.

The operation of the gates, whether initially by hand or the governor, is through these pistons. Fig. 4 shows the location of the governor, which is connected to the gate operating mechanism by the rod *e*, Figs. 3 and 4. The system of levers and rods shown is in duplicate on the two sides of the turbine in order to give a balanced effort and prevent canting, the connection of the two sets being accomplished by the shaft *f*, which extends through the wheel casing. The arrangement of rods *e* and shaft *f* differs in Fig.s 3 and 4, due to a change in design, but this will not interfere with undertsanding the principle.

The control of the pistons by the governor is through the floating levers *g* and*h*, Fig. 3, the two systems of levers being connected by the rod *i*. Referring to the right-hand gear, should the rod *e* be raised by the governor the effect would be to raise the centre of the floating lever *h*. The right-hand end of the lever being, for the moment, fixed, the left-hand end will be raised, thereby operating a piston valve on the stem *j*. Water will then flow through the pipe *k* and the valve to the lower side of the piston, which will rise and partially close the gates and also, the

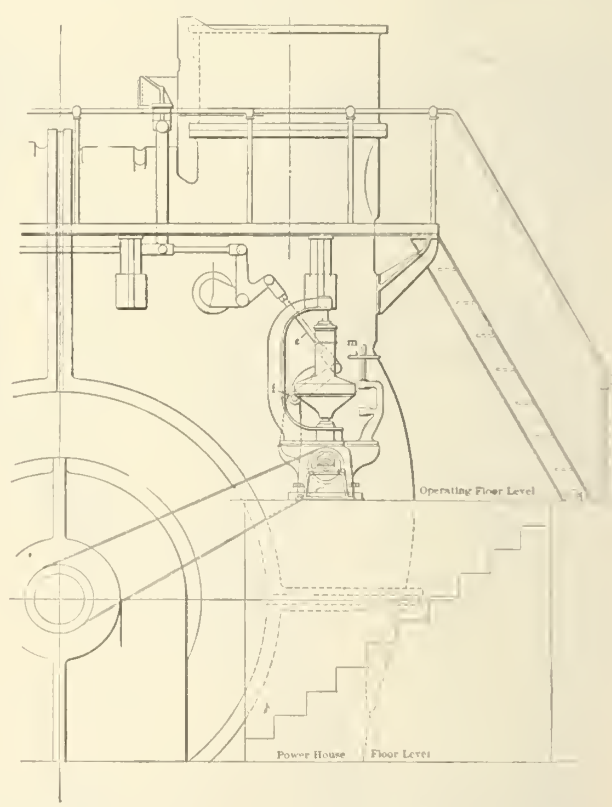


FIG. 4.—LOCATION AND CONNECTION OF GOVERNOR.

centre of the floating lever being now held in position by the governor, lower left-hand end of the lever and entirely close the piston valve, thus stopping the movement of the piston by cutting off its supply of water. Further rise of the rod *e* will cause a repetition, and a drop of the rod a reversal of the movement of the piston.

A glance at the connections will show that a movement of the governor which causes the piston valve of one side to rise will cause the other to drop, and therefore move the gate ring in the same direction. The movement of the levers and valves for either piston always takes place whether a given piston is at work or not, this being necessary to prevent locking of the non-acting piston by the water within its cylinder. A piston is thrown out of action by shutting the pressure water from it, a by-pass being simultaneously opened to permit the water to pass from one to the other end of its cylinder.

Hand operation of the gates may be effected by either the hand wheel *l*, Fig. 3, or the wheel *m*, Fig. 4, which operate the floating levers and piston valves preeisely a sthe governor does. To permit this the governor must be disconnected and the hand wheel worm gear be conneeted, for which special provision is made.

Hand operation through the hydraulic apparatus is necessary because of the large amount of power required to operate the gates. The combined capaeity of the two pistons is 90,000 foot-pounds, and the application of this amount of human energy would involve the work of a man for about half an hour, whereas by the hydraulic apparatus the gates may be closed in 1½ seconds. The long penstoek, however, makes it unsafe to cut off the water as abruptly as this, the minimum time for the eomplete operation of the gates being adjusted to five seconds.—Abstraet from *American Machinist.*

ELECTRIC DRIVE IN ROLLING MILLS.

In the proposed equipment of the great new plant of the United States Steel Corporation at Gary, Ind., now under construction, there will be noted what perhaps must be regarded as the most striking electrie motor installation in the world. The Gary plant, as mentioned in the *Engineering Record*, has a eapaeity of two and a half million tons of steel annually, and practically all the maehinery will be driven electrically, ineluding the main rolls, which have in all former plants been engine-driven. The problem of driving such rolls is a peculiarly formidable one on account of the need of taking up quickly an enormous load. It is probably the severest work upon which a motor could possibly be put. In this ease three of the motors to be used are of 6,000 horse-power normal rating, with an overload capacity of 50 per cent. for one hour, so that the rating under use will approximate 9,000 horse-power. These huge machines are of the three-phase induction type, which is peeuliarly adapted for dealing with sudden overloads, and it is very doubtful whether a direct eurrent equipment would have been eapable of meeting the requirements. The induetion motor, quite apart from the absence of a commutator and the attendant probability of serious sparking under extreme eonditions, has the unique merit of having its armature voltage quite independent of the voltage of the supply. This means that whatever voltage is desirable for the transmission of power to the motor can be freely employed, while the induced armature voltage can be made anything that will best meet the conditions of torque and control. If necessary the armature ean be made almost as solid as a flywheel, and ean be freely designed for the severest mechanical strains. Henee it is practieable to build induetion motors for uses which would be well-nigh impossible for motors using direet eurrent.

The regulation of speed in induetion motors is aecomplished by inserting resistanee in the armature cireuit. Contrary to the eommon belief, speed regulation by this means is very easy and is aecomplished upon precisely the same terms as the regulation of a common street railway motor by eutting down the applied voltage through a rheostat. It is not effieient by reason of energy wasted in the rheostat, but in the operative sense it is entirely effeetive. The motors for the rolls in the case under consideration must be capable of enormous torque and of very prompt reversal, as well as speed regulation, and the whole control is aecomplished indirectly through a deviee on the prineiple of the street car control, by which the motor ean be started, stopped, reversed and adjusted in speed. Of eourse to take up the tremendous shoek of starting up the rolls on heavy work, the aid of a fly-wheel is desirable, and eaeh roll motor is eoupled to a massive one and so conneeted, moreover, that it does the maximum amount of good. A relay earries the main motor current, and when this rises abnormally, as it does when the rolls begin their work, a small resistanee is eut into the armature eircuit, thus lowering the normal speed of the motor and throwing the flywheel energy into aetion during the slight drop in speed. Then, as the load falls off the resistanee automatically eomes out and the motor speeds up the flywheel ready for the next attaek. Big as the innovation is, there is no sort of doubt that it will be sueeessful since induction motors are admirably suited for just the hard work they must meet in sueh a case as this. They have gradually eome to be appreciated in the past decade, so that they are now often preferred to any direct eurrent motors on their merits, and have been used in many isolated plants where the use of alternating eurrent was adopted for the sake of the motors. A good induction motor is more nearly "fool proof" than anything else in the line of dynamo-electrie maehinery. It is very diffieult to burn one out or damage it by overload, and it will run in dust and dampness with far less likelihood of trouble than any other sort of motor. The Gary plant is a deserved tribute to its good qualities and should make a record that will go far toward establishing the eleetrie drive as a regular feature of rolling mill practice in future installations.

TO DISCARD A. C. FOR D. C.

The Southwestern Traction Company, of London, Ont., has discarded the three-phase alternating eurrent motors with whieh the line was at first equipped and has re-equipped its line with the standard Ameriean direet eurrent system. Mr. Mower, the general manager, has announeed that in addition to discarding the experimental a. c. system arrangements have been perfeeted for strengthening the financial condition of the eompany, and that the management will give the best possible serviee between St. Thomas, Port Stanley and London the year round. The new cars whieh have been ordered will be equipped with all modern improvements and having a seating eapacity for 54 passengers. The plans also provide for the erection of car shops, sub-station and express depot in St. Thomas.

The Brome Lake Electric Power Company have purchased the Sherwood water privilege, about a mile below the outlet of Brome Lake.

The shareholders of the Northumberland-Durham Power Company, Limited, held their annual meeting at Cobourg on February 4th, when it was announced that the Ontario Government would extend the company's lease of the lower portion of the Healey Falls and Rapids. The company are now waiting the decision of the Dominion Government with reference to leasing of the upper portion of the rapids, when the company will increase the capacity of their plant.

MONTREAL

Branch Office of The Canadian Electrical News,
Room B34 Board of Trade Building.

February 18th, 1906.

Some busy "Ward Heeler" is trying to popularize himself by asking the Aldermen of the city to prevent the Montreal Street Railway Company purchasing cars outside of Montreal, as such is against their charter. It possibly does not strike this kind party (who ostensibly is working in the interest of labor, but in reality fishing for votes) that the Montreal Street Railway Company have an exceedingly large shop purposely for the building of cars, equipped with the best machinery for that purpose, and always going full blast, in fact no good carpenter need be out of a job if he can do the necessary work on cars, as there is a position open for him there. In addition to this, however, the Street Railway Company have large orders for cars and parts of cars with other factories in Montreal, so that if they have gone to Ottawa for some it is merely to produce with more speed the additional cars which parties like the said "Ward Heeler" have been clamouring for. As a matter of fact, the Street Railway Company in many ways is the best friend to labor that ever struck the city of Montreal. Some years ago the motormen, foolishly advised, organized a strike. Their union is now non-existent, but the motormen are today better off in many other respects than had they gained the points sought for. As the daily press are continually heckling at the Montreal Street Railway Company, a few words in their favor may not be amiss.

We may have a more severe climate in our part of the world, which may somewhat affect the position of affairs, but from our own experience of water powers here, it does not seem possible that the Hydro-Electric Commission have stated a fair price for power "distributed in Toronto." True, the Montreal Light, Heat & Power Company have a monopoly here, but nevertheless should their power cost them as little "distributed," then their profits would certainly seem excessive. Thoughtful people are inclined to side with the Electricvl News in its stand.

Why this wild desire for water power, generally located at a considerable distance away from the centre of distribution? It is up to some of the smaller Ontario towns which are running municipal plants to try the Westmount idea of consuming garbage: if as successful as it is claimed to be, garbage is about as cheap as water and has to be got rid of anyway.

The contention of the Fire Committee of this city that they might be liable in the event of a fire taking place after the wiring had been passed by a Civic Inspector, is lamentably weak. In the event of the collapse of a building which has been passed by the Building Inspector, is the city liable for that building? Similar arguments could be used re other similar civic offices. No, the trouble is that the city want to saddle the Underwriters with the cost (and to tell the truth, rightly so); but, as the Underwriters in Montreal are different from those in any other civilized city on this continent and will not see their duties, surely the city will take up a matter which is urgent in the extreme. At any rate, the office could be made "self-supporting" from its fees before long.

Banquet of the Montreal Electrical Contractors.

ELECTRICAL CONTRACTORS' ANNUAL MEETING.

The regular meeting of the Electrical Contractors' Association of the Province of Quebec resulted in the following officers being elected for the coming year: President, J. E. Scott; representative director on the Builders' Exchange board, E. W. Sayer; secretary-treasurer, J. H. Lauer; executive committee, W. B. Shaw, F. J. Parsons, D. McQuaid, N. Simoneau, R. Moncel, W. J. O'Leary and Jas. Bennett.

ELECTRICAL CONTRACTORS' BANQUET.

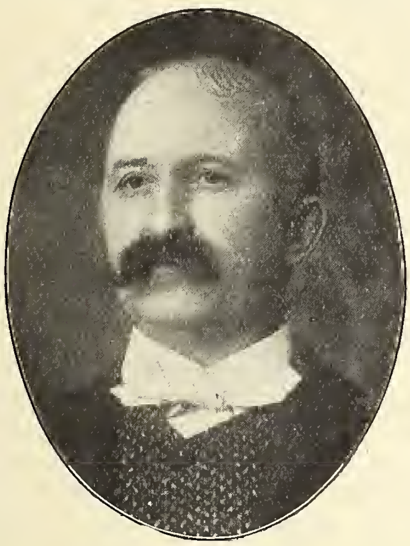
The third and most successful annual banquet of the Electrical Contractors' Association of Montreal (affiliated with the Builders' Exchange) was held at the St. Lawrence Hall on the evening of the 6th inst., the President for 1907, Mr. J. E. Scott, occupying the chair and officiating as toast master.

Among the invited guests were Mr. J. N. Arcand,

representing the Master Painters and Decorators Association; Mr. Duthie, of the Forsyth Granite & Marble Company, representing the Builders' Exchange; Alderman Mercier, for the Corporation of Montreal, and others.

In replying to the toast of the Corporation of Montreal, Alderman Mercier remarked that he had heard the request for an inspector of electrical wiring, and would use his endeavors to have a sub-committee appointed to investigate the question.

The toast to the "Electrical Manufacturers" was responded to by Mr. Drinkwater, of the Allis-Chalmers-Bullock Company, who showed the importance of the manufacture of electric motors for the general benefit.



Mr. J E. Scott,
President Montreal Electrical Contractors' Association.

Mr. Baird, of the Duncan Electric Company, also replied to this toast, signifying as a manufacturer of general supplies his interest in the inspection question.

The toast of the "Electrical Supply Dealers" was first replied to by Mr. A. Forman, of John Forman, who seconded the interest in the inspection question and stated also that he was pleased to see that the contractors had been and were sticking together. Mr. Horner, of the Canadian General Electric Company, drew attention to the fact that the importations of supplies from the neighboring Republic were growing beautifully less, and that the local supply dealers were reaping the benefit by increased trade. Mr. Walker, of the R E. T. Pringle Company, wished the contractors future success, and appealed to them to keep up the standard of electrical construction. Mr. Goodwin, of the Midland Electric Company, stated that although he was not fully acquainted with all contractors as yet, he would guarantee to know them better in a very short while, and also voiced wishes for their success.

For the general contractors, Mr. Cagney, of the Montreal Light, Heat & Power Company, replied briefly, as did also Mr. Duthie, of the Forsyth Granite & Marble Company. Mr. Duthie's remarks pertained more particularly to the legislation about to be proposed in both the Federal and Provincial Houses on the labor question. He advised all contractors to keep in touch with these movements.

In replying for the "Electrical Contractors", the veteran Mr. N. Simoneau addressed the French Canadian contingent in their native tongue, whilst Mr. W. B. Shaw spoke for the English section, pointing out that after strenuous endeavors off and on for over seven years and getting nothing but non-committal replies from the Underwriters, the contractors had at last approached the city, with the result that, as mentioned by Alderman Mercier, they now felt a gleam of hope in their efforts being a near possibility.

Some excellent talent filled in the intervals with songs, instrumental music, recitations, and the like. Two poems of Dr. Drummond's in Canadian dialect, recited by Mr. J. N. Arcand, proved amusing in the extreme, whilst the dramatic sketch of Mr. Craig Campbell describing the Battle of Waterloo "a la Henry Irving" (in character) was excellently performed.

Songs were rendered by Messrs. C. A. Mitchell, R. A. Bell and others, and solos on the English concertina by Mr. J. Gray.

At this juncture Mr. Wolff, of the Midland Electric Company, proposed the health of the President, Mr. J. E. Scott, which was drunk with the usual honors. As the evening was late Mr. Scott refrained from making a return speech, but entertained the company with a humorous anecdote. The evening drew to a close about 2 with the singing of "God Save the King."

Too much praise cannot be given to the Dinner Committee, consisting of Mr. R. Moncel, Mr. E. W. Sayer (of the Sayer Electric Company), Mr. F. J. Parsons (of McDonald & Wilson), Mr. N.S. Simoneau, and Mr. D. McQuaid (of the Century Electric Company).

The table of honor was illuminated with a beautiful spray of miniature lamps with cut glass pendants and decorated with a border of smilax, through the kindness of Mr. Sayer, who also provided the boutonnieres for each diner. Mr. Moncel in charge of one of the tables, and Mr. Parsons at the other, saw that their confreres had every attention. An efficient orchestra

Mr. E. W. Sayer,
Representative Director on Builders' Exchange.

was present during the dinner and everything passed off harmoniously, the general remark being that a very pleasant evening indeed had been spent by all.

The Filer & Harpell Company, dealers in electrical and mechanical machinery, 328 Smith street, Winnipeg, are considering the establishment of a branch office in Toronto. This company are Western agents for the Century Electric Company, St. Louis; Federal Electric Company, Chicago; Akron Electrical Manufacturing Company, Akron, Ohio; Beck Flaming Lamp Company, New York; Jones & Moore Electric Company, Toronto, and other well-known firms.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of his journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

Mica

Canada, India, and the United States are the chief sources from which mica is procured, and this pecuiar substance is daily finding new applications, particularly in electrical apparatus. For many years the chief consumer was the maker of lanterns and stoves, the mica being used entirely for glazing purposes, and it might perhaps be stated with all truth that even to-day this industry absorbs a very large portion of the total supply of the world. The term "mica" embraces a group of complex silicates, the most remarkable characteristic which is common to all being the ease with which they are split into thin, flexible and transparent leaves. One feature of mica, namely, that it is practically infusible, has made it particularly valuable, not only for stove and lantern glazing, but for electrical work. Its resistance is very high, and the fact that it is not affected by moisture makes it particularly useful in the latter application. In the thin sheet condition it is very flexible, and hence can be built into special forms of almost any design. So far as the electrical industry is concerned, the mica used therein can be best described by the word "reconstructed", that is to say, the original blocks of mica are split into very thin sheets, and these are built up again into a sheet of the desired form and thickness, various substances being used as a binder. The thin pieces are thoroughly coated with this material, and when the built-up sheets have reached the desired thickness the whole is subjected to a pressure in the neighborhood of one ton to the square inch, and is at the same time raised to a high temperature by means of steam. The resultant plate may be sawed, cut and pierced with ease, and hence we have a product which, considering its electrical properties, is an exceptionally valuable one.

New Lamps.

At the January meeting of the Toronto Branch of the American Institute of Electrical Engineers, the question of distribution was discussed, two papers being presented. One dealt with the 125/250 volt system, while the other embraced the 250/500 volt scheme, such as is common to-day in European practice. The two systems present extremely interesting possibilities, and the consensus of opinion seems to be that, so far as the cost of distribution is concerned, the higher voltage has everything in its favor. But the company must take into consideration other facts than the mere cost of copper and conduits, and, to use the English expression, must bear in mind that their business is that of supplying light, rather than mere electrical energy. The development of the two hundred and fifty volt lamp has been comparatively slow in this country. Though this lamp has undoubtedly reached a very satisfactory stage, we are considerably behind the English manufacturers in this particular branch, and the cause is apparent. The original system advocated in the United States was known as the Edison, and was purely and simply a three wire direct current distribution having a maximum voltage across the outside lines of two hundred and fifty. Such plants have been developed to an immense extent, and where the area covered became too large, the general policy of one main alternating current generating station supplying energy at high potential

to a number of distributed substations, at which points it was converted into direct current and fed into the lighting network, seems to have been followed. Hence a demand for a two hundred and fifty volt lamp did not exist. On the other hand, the use of such a scheme seems to have been prohibited in Europe through legislation, and operating companies were confronted with the necessity of taking some immediate steps to decrease the immense cost of the feeders necessitated by the lower voltage. They therefore resolved to change to the 250/500 volt plan, and simply informed the manufacturers that they had to make a lamp for this system which not only had a respectable life but also gave high efficiency, and, as one of the gentlemen at the recent Toronto meeting expressed it, the lamp was forthwith produced. This is undoubtedly the reason why the development of the European two hundred and fifty volt lamp has reached its present condition. During the past four or five years we have been seriously considering the advisability of modifying some of our low voltage systems and adopting lamps for the higher pressures. A scheme of this nature was recommended by Mr. Bion J. Arnold for the city of St. Louis, but owing to some legal difficulties the matter was not carried out on the lines originally contemplated. At Providence, R. I., however, such a system was adopted and its installation carried out completely in the centre of the city, and the management of the company reports extreme satisfaction not only with the distributing mains, but also with the 250 volt 3.8 watt lamp which was adopted. So far everything looks promising, but it must be borne in mind that when the recommendations were made for St. Louis and Providence the development of the incandescent lamp had apparently reached its highest stage. Suddenly we find a complete change in the entire condition of affairs. Messrs. Siemens & Halske placed upon the market the Tantalum lamp, and in quick succession there followed the Osmium, Tungsten, Osram and Helion inventions. It is with interest that we make comment on the fact that all these new high efficiency lamps—and some of them will give a candle power with a consumption of less than two watts—are for one hundred and ten volts, and there seems little or no chance of their ever being developed for the higher pressures. Of course this is a broad statement, but it may be noted that all the new lamps have exceptionally long filaments, and it appears almost impossible to conceive the development of such lamps for a voltage double that of the standard for which they have already with great difficulty been adapted. There seems to be no question that if these lamps fulfill their promises the present carbon filaments will have to retire from business, and hence extensive changes will be required in the systems which have adopted two hundred and fifty volts as a standard. While in many localities the lamps are controlled by the operating companies, and in passing we wish to emphasize our support of this policy, still no one can be so optimistic as to conclude that the consumer will continue to use the carbon filament when the other types of lamps will give him the same illumination with a very much lower current consumption, and hence such companies will in reality be forced into taking very active steps. The development of the new lamps is still of course in the early stages, and, while some of them have been placed on the market, we would hesitate to recommend their general adoption. The carbon filament is an altogether too well tried article to be discarded in haste, and we should rather wait and be considered unprogressive than invest a large sum of money in a type which may yet be subject to considerable development. Arc lamps, as they are used to-day, give their best results, so far as commercial lighting is concerned, on one hundred and twenty-five volts. This is another point against the higher potential. On the other hand, the Nernst lamp, while commercially satisfactory on one hundred and ten volts, really gives better service when used on a potential of two hundred and fifty. There seems to be so many different conditions affecting this matter of voltage that it is hard to know which way to turn, though we can promise that in the immediate future the electrical world will realize the long-looked for and much-sought-after increase in the efficiency of commercial illumination.

Electrical Poisoning

With the use of certain classes of electrical appliances, the formation of a greater or less quantity of ozone is a certainty, workmen who have been confined in close rooms with such apparatus for any period of time have shown symptons which clearly indicate a condition of poisoning, the most apparant being a general derangement of the digestive organs. This peculiar manifestation has been noticed in some of the Niagara plants, though the matter has received more attention in Europe than in this country. The general conclusion seems to be that the ozone combines with the atmospheric nitrogen and a certain amount of vapor of water which is always present, to form nitric acid, which enters the stomach with the saliva. The characteristic acid taste which is often perceived in the mouth when one is handling high tension apparatus is doubtless from the same source, and it is now generally admitted that ozone, when inhaled in large quantities, has an injurious effect on the throat and bronchial tubes. The difficulties mentioned are such, however, as to be easily avoided. Where these conditions exit, the necessity for ventilation is most apparent, and there is no doubt that a good many, if not all, of the troubles will disappear when this matter is given due attention.

SPARKS.

The Corporation of Ottawa is asking for tenders by March 2nd for meters, transformers, incandescent lamps, wire, globes, carbons, hardware and sundry supplies.

Mr. C. H. Mitchell, C.E., of Toronto and Niagara Falls, has recently reported upon proposed hydro-electric power developments at Prince Albert and Edmonton. Mr. Mitchell's Toronto offices are located at 1004 and 1005 Traders Bank Building.

The report presented to the Power Committee of the city of Winnipeg respecting the amount of power used in Winnipeg, outside of street railway service, shows that there were 22,077 horse power installed. The amount which has been installed by the street railway is 8,410, although only 5,200 is actually used. The amount of horse power used in private enterprises was found by the census to be 8,860 horse power. The census confirms the estimate made last summer by Mr. Cecil B. Smith that 15,000 horse power would be required. The Power Committee are planning to develop 17,000 horse power and it is felt that in view of the recent census they are justified in doing this. It is expected that plans will be so far advanced as to call for tenders for the general work at Point du Bois early in March.

ELECTRIC METER INSPECTION.

The following additional letters have been received on the subject of electric meter inspection :

I am in receipt of your letter re inspection of electric meters, and would ask, "do these figures include the twenty-five dollars ($25.00) license fee which we pay annually to the Dominion Government for a license to sell light?" If not, the inspection fees are simply outrageous. As to inspection of meters, in the majority of cases it is a complete farce. Nine times out of ten the inspectors are wholly incompetent, and the inspection is of the most superficial character, and not fair to the electric light companies or the public. The fees should be reduced fully one half or more.

You will remember that there is a duty of 35 per cent. on all electric light carbons imported into Canada, and not a single carbon has been made in Canada in ten years. In the case of the first importation of carbons made by myself after the 35 per cent. duty was put on, the Minister of Customs pretended that I was getting cut rates, and nearly doubled my invoice for customs purposes, and when I paid the duty it was nearly 60 per cent. on the invoice price instead of 35 per cent. This is the highest rate of duty imposed on any article coming into Canada. Is the Government so hard up that they require this money, or is it an effort to extort the last cent that electric light companies can bear? This 35 per cent. duty should be wiped out altogether.

This is not all the taxes the electric light companies are called upon to pay either. The local legislature impose a registration fee. Now, taking the license fee, the registration fee, the inspection of meters, and the duty on carbons, I question if the figures quoted by you would not be doubled. It is wholly unreasonable that the electric light companies should be compelled to submit to this burden any longer, and especially since very few of the companies are making both ends meet. It might be well to have some member in the Dominion House ask for a return of all license fees, inspection fees, and duties on carbons paid by electric light companies each year during the last five years. Then you will get at the taxation imposed by the Dominion Government. And also have some member in the local legislature ask for a return of all registration fees during the last year.

These are matters that should not be overlooked, and should be taken up at the annual meeting of the Canadian Electrical Association, and fully discussed and acted upon.

R. A. Corbett,
Port Hope Electric Light and Power Company.

Re fees for meter testing and inspection, would say that in view of the large revenue, the fees certainly should be reduced to a standard basis irrespective of capacity of meter ; that is, I would consider that a fee of fifty cents per meter would be a fair charge, and further that a reseal within six months after initial seal should be free of charge, instead of the present method of fifty cents per reseal, for reasons I will explain further on.

The present methods of inspecting and testing are absurd. As to inspection, the meter is never looked at, and as to testing, that is a mere matter of form, simply being tested as to its rated load and sealed as quickly as possible and the company compelled to foot the bill.

Take, for example, this company. We have overhauled all our meters, which number about 350. We called upon the Government to test same, the inspector came down with a very old stop watch of which I took special note, also a 50-ampere meter to test 5-ampere meters. What was the consequence? Simply this, we have had trouble with some of the meters, they were removed and tested with our own instrument, and found 5 to 10 per cent. fast ; some were returned to the manufacturers, being under guarantee, others were readjusted. Now, we have to pay for reseals on these. How do we know how the rest of the meters are? They were all adjusted to a 50-ampere meter, we have the certificate and have to be satisfied.

I am not placing the blame on the inspector, he has to take what is given to him and do the best he can ; that is why I state we should not pay for reseals within six months.

Re changes in inspection and testing, it is my opinion that the inspecting and testing should be made as follows :

1st—Meters should be thoroughly examined by the inspector.
2nd—Tested as to creeping.
3rd—Tested upon a fraction of its full load.
4th—Tested upon half load.
5th—Tested upon full load, then sealed and a certificate given stating the exact tests made and the results thereon.

The inspector should have the best stop-watch obtainable, also the best standard instruments, which should be carefully calibrated.

In consideration of the fact that the revenue of a company operating on the meter system depends wholly upon the conditions of its meters, it therefore follows that the inspection, testing and maintainence of its meters is one of the most important branches of the operating department and should be thoroughly organized and placed in the hands of none but the most competent men, who should follow the meters very closely and keep a sharp watch upon the Government's tests. By so doing they would eliminate a considerable amount of friction between the consumer and the company.

F. A. Chisholm,
General Manager St. Johns Electric Light Company.

In view of the fact that the Government is making a large profit on inspection of electric light meters, the rate should be reduced to such an extent that the Government should be assured of getting expenses only, as I understand it was not proposed to be a profit-making scheme.

In regard to the present method of inspecting and testing meters, I would say that the method of testing in our locality is satisfactory. I, however, feel that it is a hardship on the electric companies, not so much from the point of the expense of testing, but due to the fact that we cannot take in our meters and calibrate them as frequently as we would otherwise do it it were not for the government inspection.

In companies that I have been connected with where there was no government inspection required, we made a practice of calibrating each meter at least once a year. If we do this here and find that a meter needs adjusting, we have to break the government stamp, calibrate it and hang it on a rack until the Government inspector comes along to inspect it. I may say that our nearest Government inspector is at Halifax. This necessitates keeping a larger number of meters on hand than we would otherwise have to. On the other hand, due to the inspection, we generally let the meters go until they are due for re-inspection. In this case if a meter is found to be wrong, it is pretty hard to determine when it commenced to error, so as to make the adjustment.

A. F. Townsend,
Manager Cape Breton Electric Company, Sydney.

MOONLIGHT SCHEDULE FOR MARCH

Date.	Light.	Date.	Extinguish	No. of Hours.
Mar. 1	6 20	Mar. 1	9 00	2 40
2	6 20	2	10 00	3 40
3	6 20	3	11 10	4 50
4	6 20	5	0 20	6 00
5	6 20	6	1 30	7 10
6	6 20	7	2 30	8 10
7	6 20	8	3 40	9 20
8	6 20	9	4 40	10 20
9	6 20	10	5 40	11 20
10	6 30	11	5 30	11 00
11	6 30	12	5 30	11 00
12	6 30	13	5 30	11 00
13	6 30	14	5 30	11 00
14	6 30	15	5 30	11 00
15	6 30	16	5 30	11 00
16	6 30	17	5 30	11 00
17	6 30	18	5 30	11 00
18	6 40	19	5 20	10 40
19	10 10	20	5 20	7 10
20	11 10	21	5 20	6 10
22	0 00	22	5 20	5 20
2	0 50	23	5 20	4 30
24	1 40	24	5 20	3 40
25	2 20	25	5 10	2 50
26	3 00	26	5 10	2 10
27	No Light	27	No Light	
28	No Light	28	No Light	
29	No Light	29	No Light	
30	6 50	30	9 00	2 10
31	6 50	31	10 10	3 20
		Total............		199 30

EXTENDED TERMINAL FUSE.

The Chase-Shawmut Company have just issued a folder describing their patented Extended Terminal Fuses. Before the advent of National Electric Code fuses, the manufacturers of enclosed fuses made a type "A" or screw clamp contact fuse. In developing these fuses, the manufacturers, in many cases, made them up in different lengths for fuses of a given capacity. This fact has continually been a source of annoyance.

To obviate this, and to reduce and simplify the stock of type

"A" fuses necessary for the user to have on hand, the Chase-Shawmut Company has developed and completed a line of fuses having a long or extended terminal on one end. This terminal is made of soft copper and scored at different standard lengths. After once fitting the fuse to the base, the projections may be removed with pliers or hack-saw. This fuse will reduce the stock to one-third of the amount of fuses obliged to be carried before this Extended Terminal Fuse was developed.

LIGHTING SPECIALTIES.

The Benjamin Electric Manufacturing Company, of Toronto, have a very complete catalogue of "Benjamin" wireless clusters and lighting specialties, a copy of which they will be glad to send to anyone interested. The construction and advantages of these clusters are explained as follows:

GENERAL CONSTRUCTION.

Benjamin wireless clusters consist primarily of an insulating base of porcelain, two one-piece contact plates attached thereto—each serving corresponding terminals of all lamps in cluster and each provided with a binding screw—and a removable shell of brass or aluminum supported by porcelain rings or bushings of special design.

In series clusters contact plates are made in sections, each of which except two carrying binding screws serve two adjacent lamps. Inner and outer plates overlap each other, thus connecting lamps in series without wires.

ADVANTAGES.

1st. High Insulation.—All live proportions are widely separated from each other, and from shell and support, by porcelain bushings and porcelain base, upon which all contacts are mounted. Short, threaded socket shells, with flanges turned outward, permit lamps to pass through, thus giving wide separation between outer and inner contacts.

2nd. Simplicity.—A six-light box cluster with sockets and wires contain 123 parts. A Benjamin six-light cluster has only twenty-four, or about one-fifth as many parts.

3rd. Durability.—There are no projecting sockets to break down, nor wires pulled into small metal nipples to short-circuit, and as there are few parts to become loose or disengaged, there is, therefore, little occasion for any part to get out of order, and length of time, which under ordinary conditions cluster will last, is almost unlimited.

4th. Easy Installation.—The absence of wires does away with soldered or taped joints in cluster body. In order to install, it is necessary only to remove shell, attach base to support, connect supply wires to binding screws and replace shell.

5th. Ready Re-finish.—To re-finish an ordinary six-light cluster, it must be taken out of service, all twelve wires disconnected, sockets removed. After being re-finished, the fourteen or more exposed parts must then be re-assembled with the remaining parts, before cluster can again be put in service. There is only one piece of a Benjamin wireless cluster body that requires re-finishing. This can easily be removed without disturbing electrical connections, or putting cluster out of service for more than a few minutes.

USES.

Benjamin wireless clusters are equally adapted to in and outdoor lighting. They meet the growing demand for a grouping of small units, as over against larger individual units, perfectly. They permit use of such lamps as from time to time are most distinctly in line of progress, without the expense of a new device. For lighting stores, offices, public buildings, colleges, churches, factories, railway cars, or streets parks, pavilions, wharves, steamships, etc., they represent the highest achievement of modern illuminating art.

EXHIBIT OF THE H. W. JOHNS-MANVILLE COMPANY.

At the Second Annual Electrical Show held in Chicago from January 14th to 26th, the H.W. Johns-Manville Company, whose headquarters are in New York, had an extensive exhibit. Among its other numerous electrical specialties exhibited was a line of "Victor" direct reading instruments. These consisted of "Victor" direct current volt and ammeters, "Victor" combination meters both switchboard and portable types, as well as a special "Victor" combination meter for automobile use.

The "Victor" combination meters are the only direct reading electrical instrument of their kind on the market, giving a simultaneous reading of volts, amperes, watts and horsepower on one dial. It consists of a volt-meter and ammeter and is, therefore, practically two separate and complete instruments which are combined in one case and so arranged that the indicators cross each other, each acting independently of the other, as far as volt and ampere readings are concerned. The readings in watts and horsepower are obtained from the point of intersection of the two indicators. The "Victor" has a wide range of uses, which will suggest themselves to the practical engineer. It is claimed to be the only practical switchboard instrument giving a reading in watts and horsepower, and inasmuch as it combines four instruments in one it requires only the space of a single instrument, thus adapting it to the smallest switchboard panels.

Among the other materials exhibited should be mentioned "J—M" friction tape, which is recognized as about the best of high grade tapes now on the market. In this tape the friction is well worked into the fabric and runs true to gauge throughout the entire roll. This tape possesses an extremely long life under all conditions.

"Noark" subway and service boxes were shown of one, two and three pole construction and 250, 600 and 2,500 volt capacity. In addition to the other numerous advantages of "Noark" subway boxes, these are water-tight, being designed and tested to withstand a pressure of 25 pounds per square inch without leaking and are, therefore, suitable for the most severe conditions. Also a complete line of "Noark" National Standard fuses, blocks and accessories and "J—M" overhead line material were shown.

"Transite" controller linings are made of "Transite" asbestos fireproof lumber, an insulating material which absolutely prevents short circuiting or grounding of controller cover. "Transite" asbestos lumber is also made in the form of fireproof doors, for high tension transformers and switches, in which case it serves to protect the apparatus from short-circuiting and to prevent persons from coming in contact with the live parts.

SPARKS.

Attention is called to the announcement in this and future issues of Messrs. Kilmer & Pullen, sole agents in Canada for the General Electric Co., of Sweden, manufacturers of all kinds of electrical equipment. Messrs. Kilmer & Pullen have opened offices in the McKinnon Building, Toronto.

Messrs. Townsend & Hutt's electric light plant, at Milestone, Sask., is now in first-class running order. The plant and whole system when completed will be of high standard and speaks volumes for the thoroughness of Messrs. Townsend & Hutt in the enterprise they have undertaken. Milestone will have great reason to feel proud of the up-to-date and efficient system installed, and it is now up to the council to have street lights put in as early as possible and grasp the opportunity thus offered of having a strong advertisement of a bright, up-to-date and go-ahead town.—Milestone Mail.

The Shawinigan Falls Terminal Railway, operating the railroads in Shawinigan Falls which form the connecting link between the Canadian Northern and the St. Maurice Valley Railway Systems, have recently placed an order with the Canadian General Electric Company, Limited, of Toronto, for a 600 h.p. electric locomotive. This locomotive will be operated from the alternating current, single phase lines of the Shawinigan Water and Power Co., for the purpose of moving freight cars as required for the large factories located there. This is the first locomotive of this type to be used in Canada, and its operation will be closely watched by railway men, because, with numerous water-powers distributed throughout the country, the possibilities of the economical use of electricity for local lines is one which cannot be neglected.

Electric Railway Department

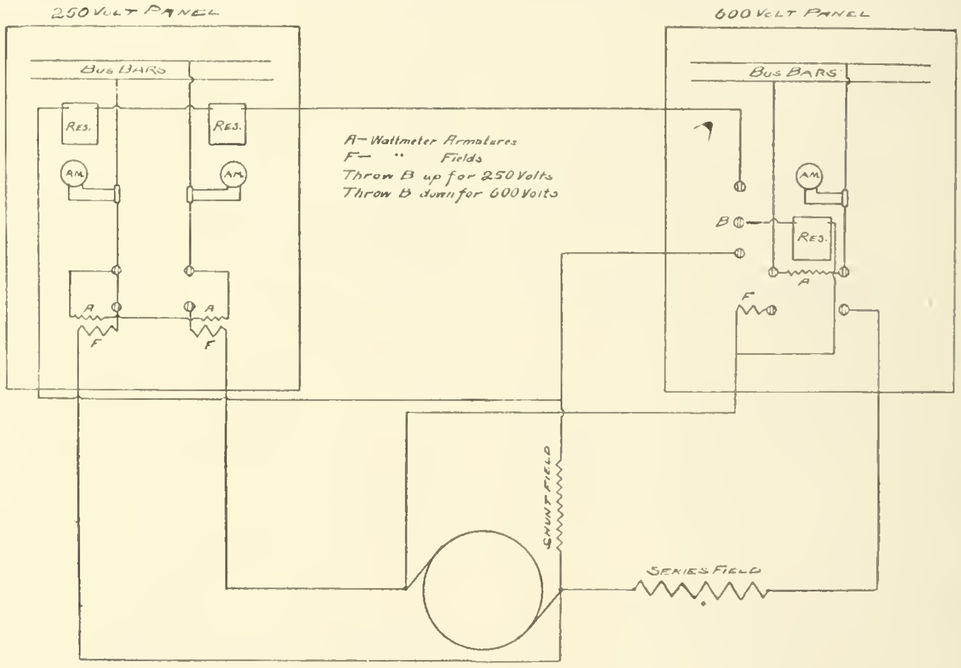
RAILWAY GENERATORS OPERATED ON A THREE-WIRE LIGHTING SERVICE.

Interesting and valuable results have been obtained by the Topeka Edison Company, Topeka, Kas., in operating a 600-volt railway generator at 250 volts on an Edison three-wire system.

The company has one of the most modern and well-equipped plants in the West. In addition to its regular lighting business it supplies current at 600 volts to the Topeka Railway Company, and for this purpose has installed three 500-kilowatt, 600-volt generators. This number of generators affords a considerable reserve capacity, which is increased by the use of a storage battery which operates on the railway service.

Anticipating an extra heavy demand on the three-wire lighting system during the present winter season, Superintendent J. T. Huntington and Chief Engineer J. L. Chase made the experiment of connecting one of the railway generators to the two outside wires of the three-wire system. To do this the generator was connected to the 250-volt panel in the manner shown in the accompanying diagram. To operate at 250 volts the compounding feature is cut out as indicated, and the field rheostat on the 600-volt panel about one-half cut out; the field resistance is then controlled by rheostats on the 250-volt panel. The engine speed was reduced five revolutions per minute by adding weights to the governor which gave a speed of 120 revolutions per minute. On the day the test was made the generator had operated ten hours at 600 volts and 900 amperes in railway service. In changing over the extra governor weights were added, switch thrown, and the generator connected to the three-wire system at 250 volts, being operated at 850 amperes for over three hours in parallel with regular lighting units. There was no sparking at the brushes and no heating of commutator above normal, and there was no trouble with regulation, which indicates that the amperage could be carried higher. The generator used was a General Electric, type M.P., Class 10, 500 kilowatt, 570 volts, no load; 600 volts full load; 900 to 1,000 amperes direct connected to a Buckeye vertical, cross-compound engine with cylinder twenty-three inches by forty-two inches by thirty inches, normal speed 125 revolutions per minute.

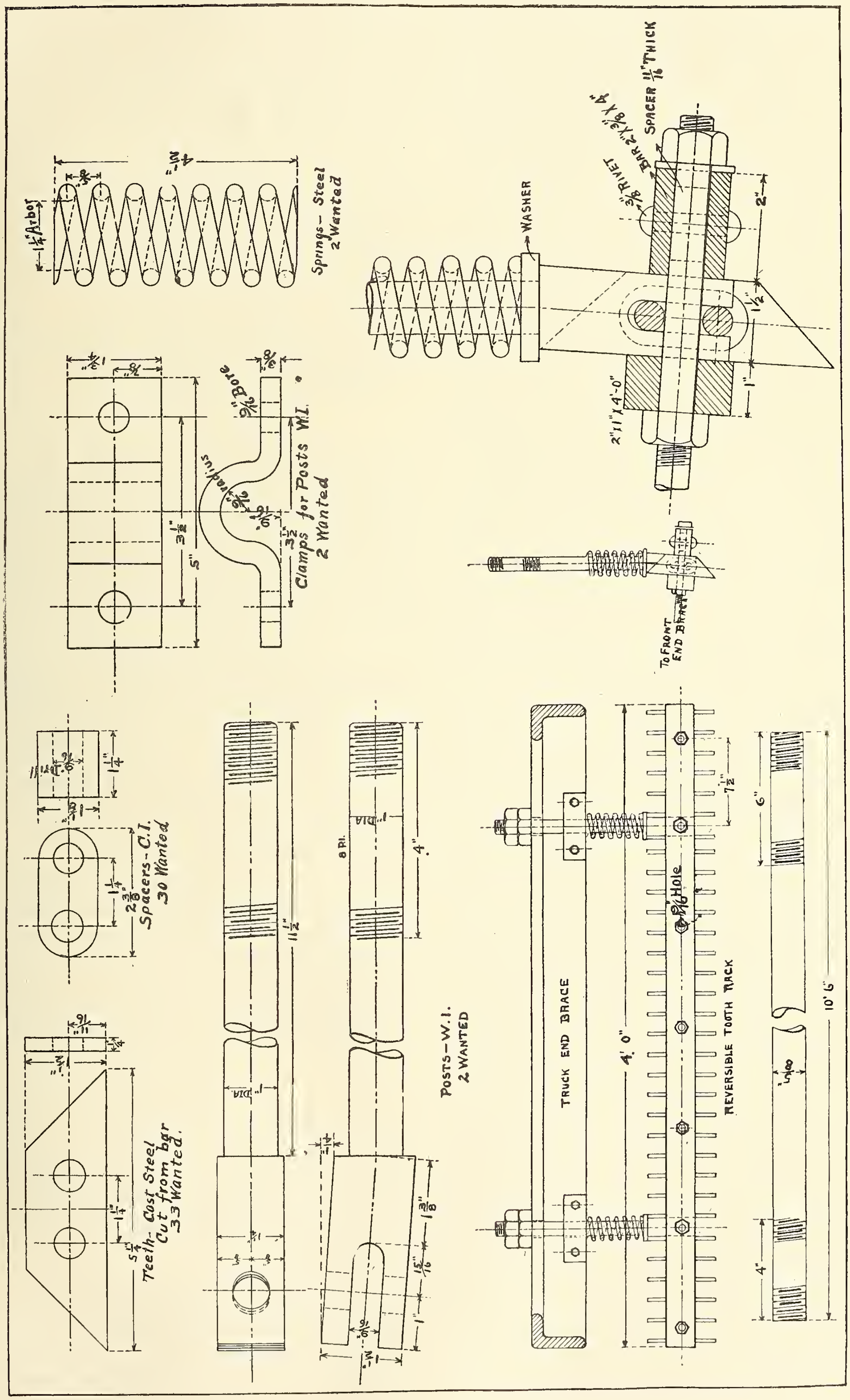
The generator can be changed from either service to the other in a few moments by the adding governor weights, and throwing switch marked "B" in diagram.—*Electrical Review.*



Plan Showing Operation of Generator on Either 250 or 600 Volts.

ELECTRIC RAILWAY STATISTICS.

According to the annual report of the Department of Railways and Canals, there were in operation at the close of the fiscal year ended June 30, 1906, 814 miles of electric railway, of which 811 miles were laid with steel rails, 195 miles being double-tracked. The paid-up capital amounted to $63,857,970, of which the municipal aid amounted to $173,000 (including $100,000 subscription to shares, and $40,000 loan). The number of miles in operation was 814, the actual increase being 21 miles. The gross earnings aggregated $10,966,872, an increase of $1,609,747, and the working expenses $6,675,038, an increase of $756,844, leaving the net earnings $4,291,834, an increase of $852,903. The number of passengers carried was 237,655,074, an increase of 34,187,757, and the freight carried amounted to 506,024 tons, a decrease of 4,326 tons. The car mileage was 50,618,836, an increase of 4,659,735 miles. The accident returns show a total of 47 persons killed during the year, 12 being passengers, 3 employes and 32 others. In addition, 1,653 persons were injured, of these 1,088 were passengers, 125 employes and 440 others; 1 employe and 1 other were killed, and 85 passengers, 13 employes and 8 others injured in collisions, derailments; 3 passengers and 2 employes were killed, and 844 passengers, 17 employes and 11 others injured, through jumping on or off cars in motion; 2 passengers and 13 others were killed, and 2 passengers and 128 others injured through walking or being on the track; 1 passenger was killed, and 72 passengers, 16 employes, and 2 others injured, through falling from cars; 4 passengers, and 19 others were killed, and 16 passengers, 8 employes, and 225 others injured by being struck by cars at highway crossings. Seven employes were injured by coupling cars. Power was supplied in 15 cases by water, and in 41 cases by steam. Ontario has 441 miles, Quebec 198, New Brunswick 16, Nova Scotia 54, Manitoba 32, and British Columbia 72 miles. Returns were received from 47 companies.



Ice Cutting Device Attached to Cars on the Montreal Street Railway. The Device Consists of a Steel Bar Having a Row of Steel Teeth which Cuts up the Ice. The Bar is Suspended by Springs from the Rear Trucks of Regular Cars, and Keeps the Rails Perfectly Smooth and of Uniform Height.

THE OPERATION AND CARE OF EXCITERS

In the following article the writer has endeavored to take up in the form of a general discussion the difficulties which may arise in the operation of direct-current machines when used as exciters for alternators. Special attention is given to those troubles which numerous complaints and requests for advice and assistance have indicated as being most common.

SHUNT AND COMPOUND WOUND EXCITERS.

Both shunt and compound wound machines are used for exciters, the former type being used where each alternator is operated with its individual exciter and where a variation of exciter voltage with changes of alternator load is not objectionable. Where two or more alternators are operated from the same exciter it becomes convenient to use the compound wound type which can be adjusted to maintain constant voltage from no load to full load, and a change in the field current of one alternator will not affect the voltage of other alternators excited from the same machine.

In the first case it is customary to adjust the alternator voltage by a manipulation of both shunt and series rheostats; as the loss in the series rheostat is wasted energy the alternator voltage is brought up by the shunt rheostat, using the series rheostat only to obtain the finer graduations between two successive steps of the shunt rheostat. In the second case the required direct-current voltage is brought up with the exciter shunt rheostat, and all alternator field current adjustments are made with rheostats in series with the field coils.

THREE KINDS OF SPARKING.

Practically all defects in design and construction, and in the improper operation of exciters, manifest themselves in the form of sparking at the brushes. In addition to being an unpleasant and disquieting condition, sparking usually means a more or less rapid destruction of the commutator and brushes, and on account of heating seriously affects the available capacity of the exciter and the proper operation of the alternator.

For convenience of discussion, sparking may be divided into three general classes: First, the small bluish white sparks, which are not particularly obnoxious, as they are not in any way destructive, and beyond a slight heating do not materially affect the operation of the machine. Second, the streaks of very fine sparks sometimes extending nearly around the commutator from one set of brushes to another. This is not a true brush sparking and in itself possesses no destructive properties and does not affect the operation beyond heating and a consequent increase of brush contact resistance. This form of sparking is invariably due to a dirty commutator, small particles of dust and dirt being brought to a white heat under the brushes and remaining luminous for an instant. The remedy is to thoroughly wipe off the commutator with a clean dry cloth free from lint. The third, or greenish yellow variety of sparks are serious, as they are not only destructive but limit the available safe output of the exciter. Every effort should therefore be made to entirely eliminate them immediately upon their appearance.

The latter form of sparking may be due to any one of a number of conditions, such as an unequal brush tension, loose rocker arm or brush holder studs, a rough commutator, or improper setting of the brushes. The tension of all brushes of each set must be equal in order that the contact resistance be the same for each brush, and that the total current will be properly divided among the brushes. For carbon brushes a pressure of 2½ pounds, and for graphite brushes a pressure of 6 pounds have been found to give the best results. The "feel" of the brush tension should never be relied upon, and the use of a small spring scale is recommended in order to obtain uniform pressure.

CHANGE OF BRUSH CONTACT.

If the rocker arm or brush holder supports are allowed to work loose, sparking will occur on account of the change of brush contact resistance with changing positions of the brushes.

ROUGH COMMUTATOR.

This may be caused by the wearing away of the copper bars allowing the mica insulation to project above the surface. The remedy is to turn the commutator true in a lathe and then carefully cut down the mica segments about 1/32 inch below the surface with a small three-cornered file. Great care must be taken to remove any small particles of copper, which might bridge across from bar to bar.

HIGH OR LOW BARS.

Unequal wear, poor brushes, excessive sparking, or poor construction may cause high or low bars to develop on the commutator, or the commutator as a whole may get out of round. The remedy is as before to true up the commutator in a lathe, but if the trouble is due to poor construction the trouble will be only temporarily overcome and a new commutator will eventually be necessary.

GROOVES IN COMMUTATOR.

Grooves may be worn in the commutator when there is no end play, or the brushes are incorrectly set and not properly staggered. The importance of end play is such that many of the larger direct-current machines are equipted with mechanical devices to make this action continuous and positive. The only remedy for a grooved commutator is to turn it true in a lathe and remove the conditions causing the trouble.

OPEN CIRCUIT.

An open circuit in an armature coil lead will cause a vicious sparking as the commutator bar to which the coil is connected leaves the brushes. The destruction will be localized upon one bar, and a temporary remedy is to bridge this bar to the ones on either side of it. The open circuit should be located and repaired as soon as possible.

FITTING BRUSHES TO COMMUTATOR.

Practically all modern exciters are equipted with carbon or graphite brushes, and in most cases the brush holder studs are supported by a rocker arm. This form of construction allows an equal and simultaneous adjustment of all brushes to the no sparking point. The brush supporting arrangement is such as to permanently spacet he several sets of brushes equally around

the commutator, and the only adjustment required is to fit each independent brush to the surface of the commutator. This is best done by using a strip of fine sand paper somewhat wider than the brush, and conforming to the curve of the commutator. Keeping the end of the strip pressed against the surface of the commutator, draw it forward in the direction of the machine rotation while the brush is firmly pressed down upon it. Raise the brush to clear each time the sand paper is pushed back for a new pull. Never use emery cloth.

OILING COMMUTATOR.

Lubrication of commutators is important from the bearing it has upon the contact resistance between the brushes and commutator. Excessive use of lubricant will form a high resistance coating on the commutator and will seriously interfere with the good behavior of the machine. At most but a very slight amount of lubrication is required. A small piece of clean rag free from lint, dipped in machine oil and then squeezed as dry as possible between the fingers, answers the purpose admirably.

SOME PRECAUTIONS.

It may appear to be superfluous to state that all parts of the exciter should be kept clean, and all connections tight; but the great majority of exciter troubles have been traced back to the neglect of one or the other of the above precautions.

Where machines are not being operated in parallel and each machine is operated with its individual exciter, it is best to turn in all the resistance of both rheostats before opening the exciter switch. This reduces the inductive kick to a minimum and prevents the danger of puncturing the insulation of the field coils, or demagnetizing the fields of the exciter.—The Engineer.

WHAT A KILOWATT HOUR OF ELECTRICITY WILL DO.

The electrical engineer of the municipal lighting plant of Loughborough, Eng., has recently published a little list showing the inhabitants what a kw-hour of electricity will do for them. It is a good way of selling electricity and of bringing home to the public mind the versatility and wide range of application of electrical energy. Our readers can develop such an idea or table for themselves. Some of the performances are a little vague, but the list as a whole is quite striking and ingenious:

Saw 300 feet of timber (deal).

Clean 5,000 knives.

Keep your feet warm for five hours.

Clean 75 pairs of boots.

Clip 5 horses.

Warm your curling tongs every day in the year for 3 minutes and twice on Sundays.

Warm your shaving water every morning for a month.

Give you 1,250 impressions on a Bremner royal printing machine.

Run a mechanical sieve for 2 hours.

Run an electric clock for 10 years.

Iron 30 silk hats.

Light 3,000 cigars.

Knead 8 sacks of flour into dough.

Fill and cork 250 dozen pint bottles.

Supply all the air required by an ordinary church organ for one service.

Pump 100 gallons of water, or other liquid, to a height of 25 feet.

Run a plate-polishing machine for 21 hours.

Run an electric piano for 10 hours.

Lift 3½ tons 75 feet in 4 minutes.

Give you 3 Turkish light baths.

Keep 4 domestic irons in use for an hour.

Keep you warm in bed for 32 hours.

Warm all the beds in the house, by a warming pan, for a fortnight.

Give you a fire in your bedroom for an hour while you are dressing or undressing.

Boil 9 kettles, each holding 2 pints of water.

Cook 15 chops in 15 minutes.

Run a small ventilating fan for 21 hours.

Run a large ventilating fan for 6 hours.

Keep your breakfast warm for 5 hours.

Run a sewing machine for 21 hours.

Carry your dinner upstairs every day for a week.

Carry you 30 times from the bottom of the house to the top, 80 feet each journey.

Keep your coffee pot warm at the breakfast table every day for a week.

Carry you 3 miles in an electric brougham.—*Electrical World.*

THE PUBLIC AND ELECTRIC WIRING.

TORONTO, February 11th, 1907.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—There is a general feeling amongst the electrical trade that the Canadian Fire Underwriters' Association do not endeavour to encourage the general public towards the adoption of iron conduits. We are unable to give any very definite information regarding what is allowed by the association by way of rebate or reduction of rates, but with what little information we can gather it appears that on manufacturing risks there is an allowance of 2 cents, with no allowance on mercantile risks. This appears to be a very meagre inducement for anybody to lay out a large amount of money. If the fire underwriters would allow 10 cents off for conduit wiring they would lose nothing owing to the increased safety, and it would go a long way towards weeding out a lot of tramp contractors and their wiring.

Canada is no doubt a long way behind the times in adopting up-to-date ideas. This might appear to reflect on the electrical inspector of the association, but by way of explanation I might add that I am quite aware of the fact that the electrical inspectors are not only in favor of more modern ideas, and that conduits have become much more practicable in the city of Toronto recently, but when the association do not extend to the public any encouragement, or appear to provide their inspection department with the facilities which they are so much in need of, it is much to their credit that they accomplish as much as they do.

There appears to be an air of mystery in connection with the Underwriters' Association, and in a city like Toronto, where the inspectors are practically maintained at the expense of the public, they should be able to enlighten the public in every way possible, with a view to educating them, or giving to the press or trade journals as much information as is required along technical lines. I believe, with many others, that if the Fire Underwriters would prepare a regular monthly or weekly article for use in the press, explaining the various points in connection with electric wiring, that it would be very acceptable and tend to spread the necessary knowledge amongst those engaged in the work to mitigate to a large extent the pleading of ignorance on the part of defaulters or transgressors of the requirements of the association.

We all want a good and up-to-date inspection system and are willing to contribute towards it, and at the same time we want to feel that the electrical department is to a reasonable extent open to us and the general public.

Yours truly,

A. G. Hall.

A NEW LINE OF CONTROLLERS.

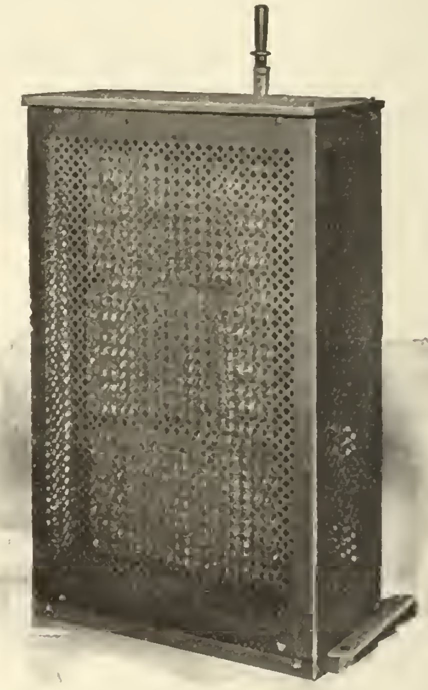
The Electric Controller & Supply Company, of Cleveland, Ohio, are placing on the market a new line of controllers, termed Type G, which have a rating of one to fifty horse-power. These controllers were built to meet the requirements of general crane service where the conditions are not severe enough to demand the use of the Dinkey Ventilated Controller. The Type G-3 and G-4 controllers are built with coil resistance, while the Type G-5 and G-6 controllers are built with cast grid resistance. When it is desired to place controllers above or in the rear of the operator the Type G controller is furnished, arranged for under lever operation. They are also furnished with spring return for operation from the floor by means of pendent ropes or chains.

A number of crane users have decided that a 15 to 20 ton crane requiring a 25 or 30 horse-power motor on the hoist and bridge motion may be operated from the floor by any of the men in the shop, thus saving the wages of a crane operator, who would probably be idle half his time. It is a very simple matter to put cut-outs at either end of the trolley travel and at either end of the runway to prevent accident. The Type G controller is claimed to meet this demand for a controller up to 50 horse-power, arranged for operation from the floor by means of ropes. This controller is a self-contained unit, the resistance being placed in the frame, making it necessary to run only four wires between the controller and motor. Reversal is accomplished by the use of a single lever, no separate reverse switch being required.

The Type G controllers are self-contained, compact, and accessible. All parts are made to jig and are interchangeable. The contact face is of heavy slate, free from metallic veins. The contact segments are of copper, which are screwed to brass lugs, to which all wiring connections are made. By this construction any of the contact segments can be removed

Type G-5 Controller—Front View.

and replaced without disturbing the wiring connections. The contact arm is of soft cast iron and carries the fingers and finger holders, the insulation of which is of heavy pressed valcabuston bushings. The contact fingers are of dropped forge copper of great hardness, and may be removed and replaced without removing the contact arm. A powerful and effective blow-out is provided in all sizes of these controllers. The frame for Type G-3 and G-5 controllers consists of a main casting in one piece provided with a cover, the removal of which affords easy access to all resistance connections. The case enclosing this frame is of perforated steel, thus allowing ample ventilation. The frame of the G-4 and G-6 controllers consists of a bottom casting which supports the resistance, and a top casting which supports the contact slate and arm. The top and bottom castings are connected by means of four corner posts, around which a casing of perforated steel is provided for ventilation and protection to resistance. The top casting of the G-4 and G-6 controllers supports the contact slate, which is completely covered and protected by a sheet steel casing. This protects the operator from coming in contact with any live parts of the controller, and also protects the working parts of the controller from dust and dirt. Easy operation is secured by a lever which is keyed to the arm shaft at the back of the top casting, which gives a short movement of about ten inches in either direction for both starting and reversing. The resistance for the G-5 controller is built of cast grids in a single bank, which may easily be removed as a unit without disturbing the other parts or moving the controller. The resistance for the G-6 controller is made of two banks supported



Type G Controller—Rear View.

on bars attached to the frame, and may be removed in separate units without disturbing the other parts. The resistance for the G-3 and G-4 controllers is made up of Type E coils, which consist of a heavy asbestos tube stiffened by means of a central brass tube, which serves to bring the rear terminal forward, facilitating the necessary connections. These controllers are very adaptable for service up to 500 volts. Six points of control are provided with the G-3 and G-5 controllers, and eight points of control with the G-4 and G-6 controllers.

Col. Ward, Commander of the Royal Engineers at Halifax, N. S., recently addressed the students of McGill University on the question of forming an association of engineers in Canada as a reserve force in case of war. The Colonel explained that he had conferred with the Militia Council at Ottawa, and prominent engineers, and had been assured of their co-operation. Prof. P. E. Nobbs, who was chairman of the meeting, also spoke on the question.

Mr. B. G. McBurney, manager of the Winnipeg branch of the Canadian General Electric Company, was in Toronto last month conferring with his company regarding their growing business of Western Canada.

Storing coal in pits capable of being flooded has been adopted at the new plant of the Western Electric Company, at Hawthorne, Ill. A plot about 320x75 feet has been excavated to a depth of about 12 feet, and lined and subdivided by concrete walls into twelve 80x25-foot pits. Their bottom is the clay sub-soil and the walls are carried about four feet above ground. The pits can be flooded by means of a 12-inch water main. The longitudinal division walls are wide enough to carry the tracks on which the coal is delivered. It is removed from the pits by a steam shovel.

General Adaptation of Electric Motors to Manufacturing Plants*

Motors in such continually increasing numbers are being used in our manufacturing establishments with such successful results, and have stood the test of practical working under so many different conditions, and for such long periods of time, that the trial stage is now past.

When power is transmitted by belts and shafts for industrial purposes, the percentage of the total horse power output of the engine which is actually useful at the productive machine (barring the limited use of ball-bearing line shafts), varies from 22% to 77%. It should be noted that these percentages are figured on the basis of horse power required to drive the shafting and belting when running light. There is good reason to believe that these losses increase with the increase of load.

As contrasted with these complications and losses, the electric drive offers numerous advantages. The system is easily installed and flexible and reliable. It is readily extended and maintained. Both generators and motors have a high efficiency, and most of the apparatus requiring skilled attention may be concentrated in the power plant.

The electric drive readily affords small sub-divisions of power so that it becomes practicable to use motors either for individual tools or for groups of tools. In either event, we arrive at a complete solution of the question of using power only when something is to be done with it, for even with group-driving, the groups may be made relatively small and of such a nature that it will be rarely necessary to drive a whole group in order to employ a single tool. There are undoubtedly numerous special requirements which can best be fulfilled by use of the individual drive, but in the vast majority of cases the application of an individual motor to each tool carries the matter altogether too far. Small motors, like small engines, are less efficient than large ones, besides costing very much more in proportion to the power delivered. The general plan which meets with the approval of the best machine shop engineers, is to employ individual drives for tools which require variable speed drive. These conditions are most often met with on machines with direct application of a cutting tool to the rotating work, provision being made if the machine is to accommodate a work piece of large diameter. When cutting on the periphery of such a piece of work a slower speed of drive is necessary than when the cut is on the part near the center of the work, the same maximum cutting speed of the tool being maintained in both instances. Even where these factors do not enter the calculation it is often desirable to drive individually on account of the comparatively large amount of power involved in a single machine, or where convenience of location of the machine is promoted by divorce from any relation to existing lines of shafting.

Probably the first application of electricity to machine shop needs was in the form of lighting. The second use was for the cranes, which are to-day in universal use in all large shops; and it is hardly an exaggeration to say that the existence of the great plants of the present time would be impossible without the electric crane.

The shop of the immediate past, with the hand or mechanical crane, and a Corliss engine driving a main shaft, which drives all the machine tools, is now being equipped with electric generators, delivering current to motors driving a group of machines or individual drives; and increased productive capacity and lower cost are resulting. At the present time, the travelling electric crane, with its flexibility of design, is really an indispensable power tool in a machine shop.

Until very recently the method of power transmission in general use in good shops consisted of a system of shafts and belting, taking power from the engine or turbine as a prime mover and transmitting it to individual tools. The application of this system was, of course, limited to the case of a single shop where the dimensions were not too great. In the case of such an establishment as a shipyard or great railroad shops, the system consisted either of a central boiler plant transmitting steam to engines located in various parts of the manufacturing area, or, in some instances, of a number of boiler plants with large engines adjacent and smaller ones at considerable distances.

The disadvantages of long lines of shafting were realized long before electricity offered a way out of the difficulty. Unless the greatest care be used in keeping the shafting in alignment and the journals well oiled, the power wasted in the friction of bearings and belts becomes a very large percentage of the total power received from the prime mover. This friction loss is continuous even when, as is often the case in large shops, a single particular tool, like a large boring mill, has to run when all the rest of the shop is shut down.

The decided advantages of the application of motors to machine tools in industrial work has been thoroughly exemplified in machine shop practice to-day. The conditions under which machine tools operate are so varied that it is impossible to make any general statement covering all of the possible operating conditions, but some of the individual conditions are always important, as, for instance, the character of the work machined, kind of material cut, shape of the cutting tool, quality of tool steel, method of treating tool steel. All of these should be taken into account to intelligently fit a motor to any machine tool.

Broadly speaking, machine tools may be divided into two classes, first, those with direct rotary motion of work or cutter, and second, those with a reciprocating motion, either of work or cutter. Under the first classification come lathes, boring mills, milling machines, drill presses, and so forth. The second class includes planers, shapers, slotters, and machines of a similar character.

The factors which have had more to do with the recent impetus given to the study of rapid production than any others are the high speed steels and the variable speed electric motors. These agents have not only brought about conditions entirely new to the

*Paper read before the Montreal Electrical Section of the Canadian Society of Civil Engineers.

manufacturing fraternity at large, but their influence has extended further, having induced a complete study of manufacturing conditions, involving not only the rapid production of work, but also improved methods of handling work between operations.

It is to be noted here that whatever the class of machine tool, the variable speed motor generally offers decided advantages in the way of rapid and economical production. With the old method of speed variation, by means of cone pulleys or nest of gears, only large increments in speed are obtainable. This invariably means that tools cannot be worked up to their limit of productive capacity. With the new high speed steels requiring a greater pulling power in the belts, and an increased strength in the gears, reasonably fine increments in speed, by mechanical methods alone, are almost impossible, owing to the increased length of the cone pulley or the necessarily abnormal size of the change gears.

For this reason, the variable speed motor may, in some cases, actually decrease the cost of the machine tool by eliminating extremely bulky and expensive mechanical speed changing devices.

The electric motor has been most successfully applied to all classes of pumps and hoisting work. For the operation of fans and blowers it has unequalled advantages, due to the ease with which it can be controlled; and to the fact that an electric equipment requires little space and may be installed wherever needed.

The present advance in shop methods and increased economy are due to the increased use of portable tools, which means less work done by hand ; therefore, the saving should be considerable. It frequently happens that it takes longer to set up a piece of work than it does to do it, hence the advantage of moving a portable tool to the part to be machined. Then there are certain classes and conditions of work for which small portable tools, such as grinders, are peculiarly adapted, and result in increased efficiency and economy.

Wherever electric energy is available, we find better heating and ventilating systems, with the exhausters for dust and shavings, and better illumination, due to the absence of belting, which obstructs the path of light and throws dust into the air, which is finally deposited on the windows and walls, giving them a dingy color. The absence of overhead shafting also gives a free space for the operation of cranes so that they may be used to the best advantage.

Keeping a shop clean is not such a difficult matter as formerly. Sanitation and cleaniness are important questions in industrial plants, and are coming in for serious attention in connection with the improvement of shop production. The conditions under which employees of machine shops work have much to do with the output. With the electric drive it is possible to maintain a clean shop, and the effect upon the character of the work cannot be otherwise than good.

Another sphere for the electric motor is in solving the transportation problems of industrial establishments. In addition to the crane and elevator service, the economical transportation of material about various parts of the plant is sometimes a formidable problem. With the electrically propelled locomotives, from either storage batteries or trolley, the transmission is economical, and these equipments have been found very serviceable, especially in the case of an establishment covering a wide area. Another valuable feature is the use of the hoisting derrick on car trucks. There are many other economies obtainable from electric haulage.

This paper will not attempt to discuss the relative merits of various systems. However, we can point out some valuable features of both the alternating current and direct current systems. These systems of power transmission have been explained so frequently that it seems scarcely necessary to touch upon them here, and it is sufficient to say that the variable speed system for direct current motors advocated by electrical manufacturers is becoming recognized as the only thoroughly satisfactory method of obtaining speed variation of motors used in connection with machine tools, namely, by means of shunt field control, either alone on single voltage systems by standard motors and the auxiliary pole motor, or the two voltage motors on the three-wire system of standard commercial voltages.

The wiring involved in the latter systems, however, is sometimes mentioned as objectionable, hence the development of the direct current auxiliary pole type motor, which presents the acme of simplicity, together with remarkable operating characteristics. The results obtained in this type of motor in eliminating sparking, and thus increasing the life of the commutator, are of direct benefit to every user of motors. The action of the auxiliary poles and windings in producing sparkless commutation is a matter, however, which will be of less interest to the user of motors than the question of how the development of the motor of this type makes a distinct saving in the layout and operation of the industrial plant. Up to the time when the auxiliary pole motor was commercially developed, there was no single voltage variable speed motor with suitable speed characteristics which could be built in all sizes required for machine tool operation, and for such speed variation as would give the best performance for each class of service. Wide speed variation, simplicity of control, and saving in wiring in the distribution system, make the handling of these motors easy for an inexperienced man, and insure a minimum amount of trouble and interruption of the work.

The characteristics of the alternating current motor are now quite generally known, and only the features which make a motor of this type desirable for machine shop or factory drive will be mentioned here. These motors are characterized by the absence of commutators, are built to withstand severe overloads, and, on account of their construction, are unaffected by dirt, iron fillings and other foreign matter.

The alternating current motor is mechanically extremely simple. It only requires enough attention to keep the oil wells filled and to see that the oil rings are rotating properly. A number of successful installations using alternating-current motors directly connected to machine tools are now in operation, and the maintenance account is extremely low.

The use of the alternating current motor is peculiarly adapted to planers, slotters, shapers, or tools of a similar nature, in which reciprocating motion is employed, provided variable cutting speed is not an object. It is obvious that on the quick reverse with machines of this character, unless the motor is abnormally large, or a fly wheel be employed, there is

imposed a considerable momentary overload upon the motor. These overloads will be more readily taken care of by the alternating current motor than by the direct current motor, for the reason that overloads on direct current motors, if severe, will, if the overload capacity of the motor is not adequate, be accompanied by flashing at the brushes.

The alternating current motor, involving as it does, no commutator, which must be more or less accessible for cleaning and inspection, permits of a greater mechanical protection of the windings than is possible in the case of the direct current motor.

For group driving, the alternating current is specially desirable. For individual drive, where the conditions are of a definite character, and where the quality of the material operated upon and the tool steel are not liable to change, the alternating current motor furnishes an ideal drive so far as simplicity of construction and general reliability are concerned. In the case of the alternating current motor, speed changes must be made by means of some variable speed device other than the motor, as the motor itself is essentially a constant speed machine. Hence it is peculiarly adapted to grinding operations and for the operation of certain classes of wood-working machinery, or tools situated in places that are not free from moisture, acid fumes or inflammable materials. It may be placed in the hands of unskilled operators and requires no skill or attention worth mentioning, and will bear overloading and abuse almost beyond belief—but the greatest advantage of the alternating current system is that it can be transformed either in voltage or phase and adapted for long distance transmission. The alternating current motors may be used in connection with direct current motors. Both alternating current and direct current systems have become quite common for industrial and railroad plants. In these installations, the main generators are of the polyphase alternating current type, direct current being obtained by means of rotary converters or motor generator sets.

So one might go on discussing the manifold advantages of the application of electrical energy in our industries. It is only necessary to assemble in one's mind the factors that have made possible such rapid advances in the past to appreciate the future conquests when our water powers are fully developed.

To intending purchasers of electric equipments, a number of considerations may be presented, as the customer, not always having the advantage of special knowledge or experience, may lack time and facilities for testing out before purchase; and works managers and superintendents may be in doubt as to the paying value or comparative merits of the machines and devices drawn to their attention by enterprising supply houses.

We might say first, that the motor should be of general adaptability. This is most important, as it largely governs the selection. It should be maintained and operated at low cost.

As is usually the case, the simplest and most compact motor of light weight and of few parts, is at once the most adaptable, and easiest to maintain. Fewness of parts calls for less material. What is here said of manufacturing costs applies equally to repair expense; with fewer parts there is less liability for wear, for lost motion, for breakage; there are fewer "extra" pieces to carry in stock, and there is increased time service. The strongest motor is not the heaviest; the most powerful is not the largest.

In conclusion, the electric drive, whether individual or group, from present successful installations, greatly increases the general reliability of the plant.

PERSONAL.

Mr. J. L. Belnap, who for some time has been district manager in Winnipeg for Allis-Chalmers-Bullock, Limited, has been appointed manager of sales for Eastern Canada, with headquarters at Montreal.

Mr. John Doucette, a superintendent for the Hamilton Cataract Company, died last month at his home, 379 Wilson street, Hamilton, at the age of 54 years.

One of the most prominent citizens of Quebec passed away last month in the person of Mr. Andrew Thomson. He was one of the principal promoters of the Quebec Railway, Light & Power Company, of which institution he was president at the time of his death. He was largely interested in financial and industrial enterprises, being for 25 years president of the Union Bank.

Mr. W. A. Duff, assistant manager of the Montreal office of the Canadian Westinghouse Company, has been promoted to the Western managership of that company, with headquarters at Winnipeg. Mr. Duff has been identified with the Westinghouse interests for some years, and his promotion is well deserved. He is a graduate in electrical engineering of McGill University, and well known in the electrical engineering field. Before leaving Montreal his office associates, numbering thirty, tendered him a banquet, at which were expressed their best wishes for his continued success.

MR. W. A. DUFF.

Mr. Thomas R. Loudon, B.Sc., of Toronto, has been appointed general manager and secretary of the Canadian McVicker Engine Company, of Galt, Ont.

The staff of the Toronto Technical School recently honored their retiring principal, Dr. Pakenham, by presenting him with a handsome grandfather's clock.

Mr. William A. Black, an old official of the Toronto Street Railway, being one of the first roadmasters appointed, died at his home in Toronto early in February.

Mr. Thomas A. Edison, the inventor, celebrated the anniversary of his birthday on February 11th. To a reporter he said: "For 45 years I have been making experiments with electricity, but all those years I have been turning these experiments to commercial value so fast that I have not had a chance to play with electricity for the fun of the thing, just to see how much I can find out about it. But from to-morrow on, I am going to give up the commercial end of it and work in my laboratory purely as a scientist. That will be the pleasure I have long been promising myself."

Meters and Meter Reading

By Norman Macbeth.

Practically all of the meters in general use to-day are watt hour meters, also frequently called integrating or recording watt meters. The dials register the use of electrical energy in watt hours, which term is defined electrically as a current of one ampere flowing under the pressure of one volt for one hour. Bills are ordinarily figured in thousand watt hours or kilowatt hours, which is practically the result of eighteen to twenty sixteen candle-power lamps, depending on the efficiency of same, burning for one hour, or nine or ten lamps for two hours, etc. An electric meter is an electric motor, the speed of which depends on the amount of energy flowing through same as required for lamps or motors on a consumer's service, and should not register when current devices are not in use. They do register, however, when over compensated or too finely adjusted to overcome the friction

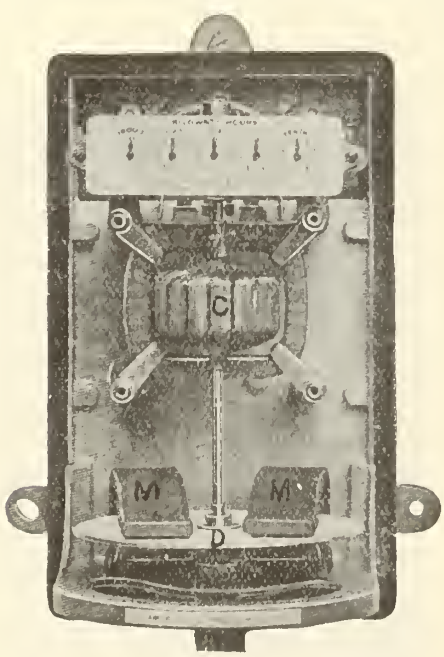


Fig. 1.

of the bearing; this condition is called "creeping." The shaft or armature of this motor is in an upright position, the top of same connecting with the gearing on the back of the meter dials (Fig. 1). A very small force would cause the armature C to rotate very rapidly and it is necessary to provide some means for governing the speed and the action of same. To accomplish this, permanent magnets MM are provided between the poles of which a disc D attached to the armature shaft revolves. These magnets have a breaking effect on the disc, retarding its speed. A slight change in their strength, due to improper ageing, an overload of the meter, or a short circuit will cause a change in their strength and a considerable change in the accuracy of the meter. Weakened magnets are responsible for a large number of fast meters, show a considerable increase in the monthly bill, without value received. In other words, a fast meter does not increase the efficiency of a lighting or power installation. The lamps do not give more light nor will the motor have done more work than on a bill for a lesser amount on an accurate meter.

(Fig. 2) Dials all register in tenths or tens, the lowest reading pointer being the one on the extreme right facing the meter. It will be seen that the ratio of velocity of the neighboring pointers is ten to one, the wheels of the shaft to the right gearing into the pinion of the shaft just to the left of it. This accounts for the alternate direction of rotation of the pointers. The value of one division on the first dial on the right is one-tenth, the next dial units, the next tens, the next hundreds and the next thousands. The value of

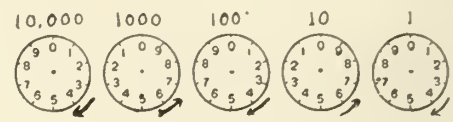


Fig. 2.

these divisions, however, is placed by different manufacturers at various points. In some meters they are tenths, some units, or quarters, halves or multiples of ten as the case may be, according to the constant or dial values as marked on the face of the dial. These values must be determined by a careful consideration of the figures given above or below the dials and with reference to the illustrations following it is hoped that a fair understanding may be secured.

Each dial, you will note, is divided into ten divisions, one revolution of the pointer of any dial is equal to one division of the dial of next greater value. Dials are read in the order beginning with that having the lowest capacity, writing the result from right to left. In the reading of the dial shown in Fig. 3 the upper right-hand or tenths dial reads 9, the second dial 4, being practically nine-tenths past 4 and will not be 5 until the first dial has reached nought or zero. The third dial reads 9, being four-tenths of a division past 9. The fourth dial reads 1, being nine-tenths of a division past 1; this dial will not read 2 until the previous dial reaches nought, which will not occur until the second dial has gone around practically five-tenths of a revolution, when the first dial will have gone around over five times. The last dial reads 4 and as each division of the first dial is one hundred watt hours or one-tenth

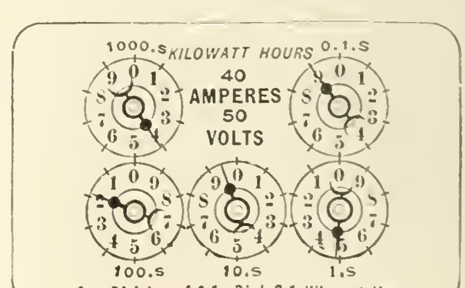


Fig. 3.

kilowatt hour, the result is 4,194,900 watt hours or 4,194.9 kilowatt hours, placing the figures as read from right to left.

Owing to the closeness of the observation required and the possibility of error caused by the angle at which the observation is taken, it is necessary to read all dials after the first in connection with the one of next lower value and from a point where the line of observation will be at right angles to the dial face. In

Fig. 4 all dials are at zero, although they do not appear to be, owing to the angle.

In Fig. 5 one complete revolution of the right-hand dial is 1,000, therefore each division is 100—this dial reads 9,112,800, and should be considered only as the

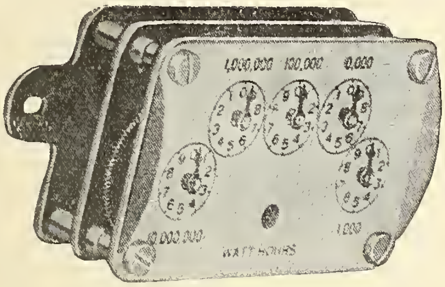


Fig. 4.

meter registration, the value of this result depending on the multiplying constant of the meter or the value of the units as stated on the dials.

Fig. 6, each division of the right-hand dial marked tenths is one-tenth of a kilowatt hour, or 100 watt hours, and reads 1,965.9 kilowatt hours.

Fig. 7, each division of the right-hand dial marked 100s is 100 kilowatt hours and reads, 9,704,500 kilowatt hours.

Fig. 8 is rated in 100s-watt hours, not kilowatt

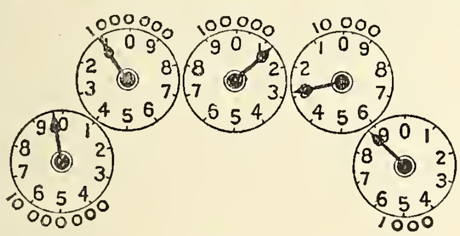


Fig. 5.

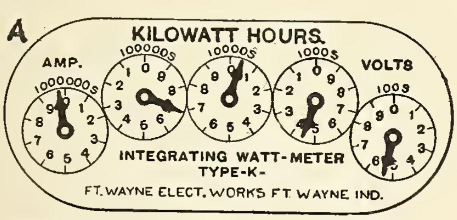
hours as in Fig. 7, and therefore reads, 4,194,900 watt hours or 4,194.9 kilowatt hours.

Fig. 9 reads in 1000s-watt hours and reads 20,-581,000 watt hours or 20,581 kilowatt hours.

Fig. 10 reads in 1000s also, but in this case as in Fig. 9 each division of the lowest dial is 1,000 kilowatt hours or a total of 26,583,000 kilowatt hours.

Fig. 11 has but four dials, the lowest value being 1s in kilowatt hours, gives 9,659 kilowatt hours.

Fig. 12 reads in dollars and cents direct, the meter being adjusted to conform to the rate in cents per kilo-



READING-9704500 KILOWATT HOURS.

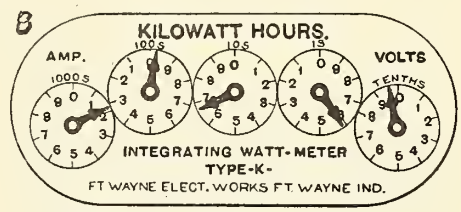
Fig. 6.

watt hour, the first two dials on the right reading in cents and the balance in dollars.

Fig. 14 uses but four dials and reverses the direction of rotation of the first dial indicating 0,561 kilowatt hours. With this exception, all the above dials of lowest value revolve in the same direction as the hands on a clock.

Meter readings are accumulative and always represent total registration from the time the meter was started. To obtain registration for any given period, deduct reading at beginning of period from that at the end, multiply the result by the constant for watt hours, or place a decimal point if the lowest dial reads in tenths, or tens, units or decimal parts of units.

The following set of dials, being taken as more than ordinarily difficult, when understood should qualify any consumer to read his meter. Suppose a meter were installed for a load of 50-16-c.-p. lamps or a 3 h.-p. motor in use six hours per day, meter installed June 20th with all dials at zero. On June 27th, after five



READING-1965.9 KILOWATT HOURS.

Fig. 7.

days and a half run, the meter reads as in diagram 1. The first or lowest dial on the extreme right indicates .7 (seven-tenths), the next 1s indicates 9, the next 10s indicates 9, and the next, or 100s, rests apparently on 1, but since the 10s dial has not yet completed its revolution the 100s dial indicates 0 as does also the 1000s dial, making a total reading of 0099.7 kilowatt hours and a charge from June 20th to June 27th of 99 7 kilowatt hours, or 99,700 watt hours. On August 22nd, 48 days later, the dials appear as

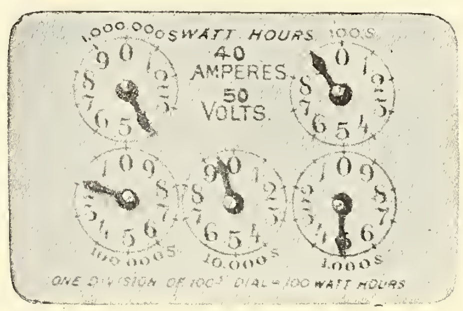


Fig. 8.

in diagram 2, 0909.1, from which we deduct the reading on June 27th, 0099.7, giving a registration of 809.4 kilowatt hours for June 27th to August 22nd. On August 28th, five days later, diagram 3 reads 0999.9, deducting 0909.1 of August 22nd gives 90.8 kilowatt hours for August 22nd to August 28th. Half an hour later this reading is verified by diagram 4,

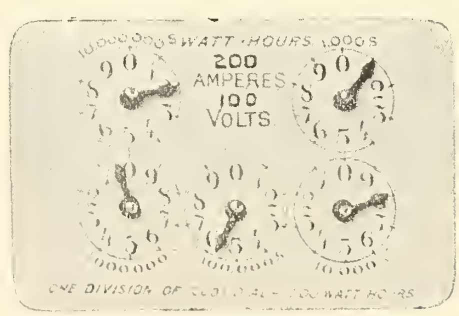


Fig. 9.

when the dials show 1000.1, an addition of .2 kilowatt hours or 200 watt hours.

On September 5th diagram 5 reads 1111.1, from which subtract previous reading 1000.1, showing a use of current to equal 111. kilowatt hours. Always read the figure the pointer has passed, proving same by reference to the next dial to the right. An over reading

or an under reading will not be fully corrected on the following charge if bills are subject to a sliding scale of discounts.

In taking regular records of meter readings read as blank dial cards similar to Fig. 2 should be used, as it is easily possible to make mistakes by taking the values direct in figures. A record of this kind may be worked out later by one more conversant with meter readings. Care should be taken, however, to mark each pointer exactly where it appears on the dials. A dial read from the angle of Fig. 5 would appear and might be

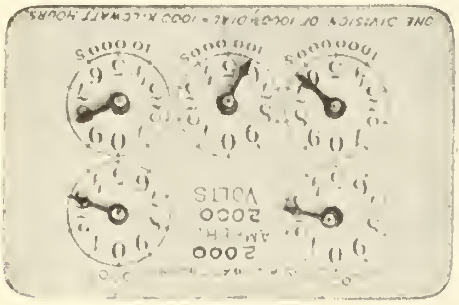


Fig. 10.

read as 0919.0, but when worked out carefully beginning at the right hand dial, would prove all dials at zero.

Watt hour meters on lighting circuits are the acme of the "heads I win, tails you lose" system of getting all that the tariff will stand.

One 16 c.-p. lamp, burning one hour at the normal rated voltage, will give 16 c.-p. equivalent in light for an approximate charge of 50 watt hours. Suppose for

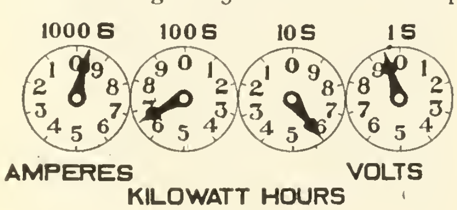


Fig. 11.

comparison the rated voltage is 110 volts, with a correctly rated 110 volt lamp, the voltage drops to 108 volts, or actually 1.8 per cent., the candle-power will drop 9 per cent., or to 14.55 c. p., while the watts per hour remain about 48, or a reduction of less than 4 per cent. Again a drop of less than 4 volts to 106.2 will show a reduction in candle power to 13.2 c. p., or 17½ per cent., with a reduction in the watt hour charge of only 6.8 per cent., a charge of 46.6 watt hours.

From the above you will note that all reductions in

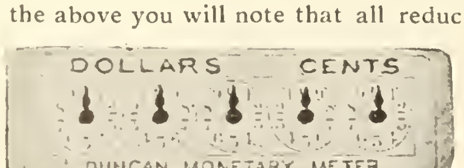


Fig. 12.

light due to voltage fluctuation have a considerable influence on the light delivered, but little on the revenue returned percentage in watt hours, resulting in equal percentage in dollars. Increases in voltage act quite the same way, with always increased revenue as a premium for faulty service.

A consumer decides that he can afford to use incandescent lamps to light a particular part of his store, when the lamps are in use possibly six hours per day. The estimates are carefully made as to the probable cost, based always on the rated voltage of the lamps to be installed; 110-volt lamps are regularly used, or perhaps 108-volt lamps labelled 110. During periods off the peak of the load, when fewer consumers are using current, before 4 p.m. or after 7 p.m., the voltage runs up to 120, only an increase of 11 per cent.; the watt hours charged by the meter, however, will be 26½ per cent. additional. Of course it will be explained you get much more than 16 c.-p. in light, but for a very short time only, and this gentle roast re-

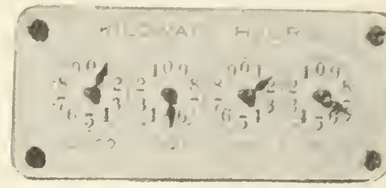
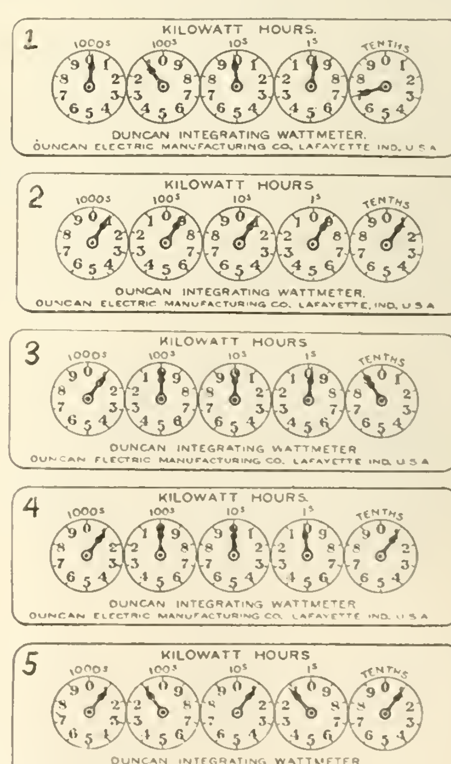


Fig. 13.

peated a few times will leave your lamps where the original rated candle-power will be a thing of the past, and the lamp salesman will get about 60 per cent. more business than anticipated.

The above conditions prevail mostly on alternating current circuits, excepting on direct current, where at this time of the year consumers are more generally making a demand for the capacity of the generators and the much talked of "machinery lying idle throughout the greater part of the year to supply the total demand for fifteen minutes during the extreme peak on a certain day in December" fails to respond, the law of average having been too finely shaved down. Should a consumer protest, very satisfactory explanations are given by the company's representative, who in many cases is not conversant with the conditions nor capable of making a clear statement of fact. A young college graduate, whose father has stock in the company or desirable political connections and ambitions to represent a large corporation, quickly assumes the popular idea of "monopoly corporation importance," and shoulders it all himself—the consumer can either figure out that he is being handsomely treated or he may return to gas. "Our service is above common criticism."

Thousands of consumers during these winter months will pay for "hot wires" 20 per cent. and 30 per cent. below rated candle-power, almost as much as for the



light they contract for and which their company agrees to give them, subject to the usual contract protection of "unforeseen demands and acts of Providence" beyond their control.

Watt hour meters make this condition possible as they constantly add to the revenue whichever way the voltage goes.—The Illuminating Engineer.

TELEGRAPH and TELEPHONE

THE FUTURE TELEGRAPH SYSTEM.

A greater part of the telegraph systems of the world are conducted substantially according to the methods introduced by Morse. The Morse code is still in use and the Morse key and sounder, with practically little change. However, W. J. White believes that signs are not wanting that a critical period in the history of telegraphy has been reached. The requirements of commercial life to-day are such that the older system is barely able to cope with them. Progress obviously will lie in two directions : the maximum output of a system must be secured, and the cost of operation must be reduced. These two developments are, to a certain extent, antagonistic, so that to secure one advantage the other must be sacrificed somewhat. A brief review is given of various attempts to increase the capacity of a telegraph system, but none of the machine systems is thought to be entirely satisfactory. There is one feature in common with several of these systems ; they require some kind of synchronizing device for their operation. Synchronism is at all times difficult to secure, and this difficulty is thought to spell failure to many projected type-printing systems. The ideal type-printing telegraph should be free from any synchronizing device. The great feature of the Morse system is its reliability. It will work not only under favorable conditions, but when conditions are most unfavorable. When quadruplex working is not possible, duplex can then be worked ; and when this fails, simplex. If simplex can not be worked there is no telegraph system that can. With machine telegraphy the case is different. The slightest thing wrong with the synchronizing arrangements is sufficient to throw the whole system out of order, and it is necessary to have a Morse signaling set to control the working of the apparatus, so that the advantage often claimed for machine telegraphy—that it dispenses with the need of specially trained operators—is nullified. A second factor in the universal adoption of machine telegraphy is that of cost. The machine telegraph of the future will overcome, as far as possible, these disadvantages. It must be simple. The ideal is a typewriter keyboard operated by any one who can use a typewriter. An instrument at the other end should record the message in Roman characters, preferably in page form. What is wanted is a simple system in which the operator writes out at one end of a cheap line, and the message comes out written in page form at the receiving station.

For lines which are more costly the line must be capable ef being duplexed or quadruplexed. In any case the total message cost must be such as to enable the system to compete with all others, whether telegraphic or telephonic. Minor developments will probably come into being in connection with commercial work. Big business houses will have their private telegraph lines to the nearest office, a typewriter telegraph instrument being placed on the desk. An operator will write messages previously dictated. These will be received on a printing machine at the main office. An indicator will warn the operator there that the message is waiting. It will be taken from the receiver and dispatched to its destination without delay. In a few moments the merchant for whom it is intended will receive a signal on the instrument in his office and, going to it, will get the message.—Abstracted from Electrical Review (London).

GOVERNMENT TELEPHONE SYSTEM IN ALBERTA.

Specifications are said to have been completed, the necessary exploratory work done and the route chosen for the line between Edmonton and Llyodminster. The Government is now advertising for 7,000 poles, and is calling for bids from the leading telephone supply houses of Canada for the wire, insulators, cross arms and other items of construction.

The route selected will take the new line to Fort Saskatchewan on the north side of the river and, crossing there, will be carried eastward in the same general direction as the Canadian Northern, but for the greater part of the distance following the section and range lines. Every town on the railroad between Edmonton and Lloydminster will be connected with the system, and towns to the north and south will later on be connected up with branch lines. The new line will be copper wire construction throughout, central energy.

There will be 400 miles of drawn No. 10 copper wire, weighing 66,000 pounds. Besides this it will take nine miles of soft copper wire to attach the main lines to the insulators, bringing the total order for copper wire to nearly 35 tons.

WIRELESS TELEPHONY.

The German Society of Wireless Telegraphy has succeeded in holding wireless telephonic communication between Berlin and Nauen, twenty-four miles away. Prof. Slaby, in an interview, described the experiment as eminently successful. The conversation was carried on partly by Herr Von Sydow, under secretary of the postal department, who received perfectly intelligible repetitions to his questions. Prof. Slaby says the problem of wireless telephony is solved, but that the limit of distance is not yet known. He sees no reason to set any limit of distance, and believes that the time is coming when a man will be able to speak wirelessly to a friend in any part of the world. The method employed to-day consists of the use of the microphone in connection with the ordinary wireless telegraph apparatus.

SHORT-CIRCUITS.

Telephone greetings between Winnipeg and Moose Jaw, 398 miles west, were exchanged December 28th. It was the first press message over the new copper wire circuits of the Bell Telephone Company and the Saskatchewan Telephone Company. The extension of the long distance 'phone to the western Saskatchewan city marks another milestone in the rapid development of the great Canadian west.

It is just twenty years ago since the first message was sent by wire from New Westminster, B.C., on the shores of the Pacific and Old Westminster on the historic Thames, by the C. P. R. Telegraph and the Bennett-Mackay cable, over a circuit comprising 4,000 miles of land from New Westminster to Canso, and over 2,000 miles of sea from Canso to England. This was by far the longest circuit ever before worked. The operator at New Westminster ticked off the message, which was the next moment 6,000 miles away. The message was repeated at various points by automatic repeaters.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Would you be good enough to furnish me, through your "Questions and Answers Department", with some general information on transformer testing?

Answer.—The simplest test, and yet one of the most important, is that of insulation, or as it is commonly called according to the way the test is made, the puncture test. This merely consists in the application of two or three times the standard primary voltage between windings, and between windings and the core. Although the grounding of the secondary is a measure valuable in the prevention of accidents, still it is certainly important to have transformers in which the insulation between the primary and the secondary is of a high class. High voltage for such tests may be readily obtained by means of two or three standard transformers, the secondaries being connected in parallel across low voltage mains, and the primaries being connected in series. The cases of the transformers so used, however, should be carefully insulated from the ground. The core loss can be measured from the secondary side of the transformer, the primary being on open circuit during the test. A wattmeter in the secondary circuit will indicate the core loss directly. It is of importance of course in conducting such a test to have the voltage and frequency exact. The copper loss which is present is so small that it need not be considered. For temperature, ratio, efficiency and regulation tests, the transformer may be connected from a source of power and in such a way as to supply a lamp bank or other suitable load, an ammeter and voltmeter being connected in both the primary and secondary sides. With no load on the secondary, the readings of the two voltmeters will show the ratio of the transformer. With full load on the secondary, a drop will be indicated by the voltmeter on this side of the apparatus, and from this drop the regulation can be obtained. The transformer may then be run for a given number of hours with full load and its temperature taken. At full load, the readings of all instruments will also show the efficiency, and if it be desirable, other readings may be taken at greater or less loads. The above are the very simplest tests which will usually be required by average size central stations, and these tests will apply generally to transformers of average size intended for use throughout the general distributing system. Where large transformers are to be tested, or transformers of special nature, there are various methods available whereby regulation, heating, etc., may be ascertained without the large expenditure of energy which would be required by the above outlined methods. We presume that your requirements are for small transformers, and hence we have given the data above.

Question No. 2.—Four double pole lightning arresters of the C. G. E. station type are connected in series on each 11,000 volt line. These arresters are arranged with brass knobs and carbon rods with porcelain barriers. I have been informed that these carbon rods should be replaced every year, as their resistance is affected by lightning discharges. Is this true of this type of arrester, or any other type using carbon rods? How often should these carbons be changed?

Answer.—In reply to this question we may say that some forms of lightning, when discharged through the arrester mentioned, produce a marked change in the carbon rods. This change, however, will always be apparent to the eye, and the man operating the plant will not have any doubt whatsoever in his mind but that the rods should be immediately replaced with new ones. If the rods show no change in form we think it would be quite safe to continue their use, though of course their first cost is small, and a replacement in cases of doubt is in any event an exceedingly cheap form of insurance. It is probable that the metal electrodes will require more careful watching than the carbon rods, for, in the event of a heavy discharge passing through the arrester, the surfaces of the electrodes may be pitted and thus the gap increased, or, on the other hand, a small globule of metal may be formed in one of the gaps, and thus the distance between adjacent electrodes decreased. These electrodes may be easily removed and cleaned, or, in the event of serious burning, may be slightly turned, thus bringing new and perfect surfaces into position to form the gap. The diameter of the hole in these electrodes is somewhat larger than the bolt which holds them in position, and hence there is sufficient margin to enable the correct adjustment of the air gaps to be easily made. We would be inclined to think that our remarks above will apply to practically all arresters using carbon resistance rods. Of course in some types the gap is formed between carbon surfaces, and hence every discharge is liable to produce a marked change in the width and shape of the gap.

Question No. 3.—What type of lightning arrester do you consider best adapted for a three-phase, 11,000 volt transmission line?

Answer.—We regret that the above question refers to the relative value of different makes of apparatus, and therefore, as mentioned in the general rules given at the head of this department, cannot be considered in these columns. We might say generally that an arrester which would be satisfactory for your plant should be made up of a certain amount of non-inductive resistance together with an air gap of proper length, and that the connections should be such as to give an equal resistance and an equal air gap between line and line, as exists between any line and the ground. The combination of resistances and air gaps between line and ground limits the possible rise of potential between such line and the ground, and it is also desirable that the potential between line and line shall not in any case exceed this value, and hence the desirable incorporation of the connections above mentioned.

Question No. 4.—The outside brass plates for holding the laminations pressed together in a stationary

armature type of generator have in a few places sprung out at the finger ends, which allows the laminations to vibrate, causing considerable noise. How should I remedy the trouble?

Answer.—To answer the above question properly an examination of the apparatus would have to be made, and we would therefore suggest that you communicate the facts in the case to the maker of the machine. This is a trouble frequently encountered in alternating current apparatus, and often occurs in generators, motors and transformers. In one case brought to our knowledge the defect was most desirable, namely, where a potential transformer was mounted on a switchboard. It so happened that at proper voltage the hum produced had a very distinctive sound. About one per cent. below normal voltage the sound disappeared entirely, and about one per cent. above normal it became quite discordant. It was proposed to replace this potential transformer at one time on account of the loose lamination, but after due consideration had been given to the matter, it was decided that its peculiar properties were a most valuable adjunct, and it is still in use to-day. Possibly in your case a cement of some kind might be inserted between the loose laminations, and the whole pressed tightly together, so that when the cement dried the laminations would adhere firmly to each other and the vibration cease. You can no doubt remedy the difficulty by some such simple treatment as the above.

ENCLOSED ARC LAMPS FOR WINNIPEG.

Mr. F. A. Cambridge, the Winnipeg city electrician, has sent in his report condemning the present direct current open arc lamps as used in the lighting of the city, and as a result the city will order at once two hundred enclosed arc lamps. The following is a synopsis of the City Election report:—

"Having been requested by the chairman to get out the estimates for the coming fiscal year, it is necessary before doing so to have a decision arrived at as to operating the present 200 direct current arc lamps.

"These lamps are supplied by three direct current generators and must either be driven by steam power or by a motor. To continue to drive these by steam power will cost $18,056 per year, while to drive them by motor at May street station will cost $8,156 per year plus a proportion of the building and labor cost of that station.

"It will be far better, however, to entirely discard the direct current dynamos and lamps and purchase the same number of alternating lamps, together with necessary regulators, as under the latter system the yearly cost will only amount to $4,467 plus proportion of building and labor cost; this sum includes allowance for interest and sinking fund on the discarded apparatus, or a saving per year of $13,589.

"The alternative plan of driving the dynamos by motors, while making a saving over steam of $9,900, is still $3,689 higher than the cost of an alternating current supply, and only saves a capital investment of $6,000 for alternating current arc lamps.

"The direct current open arc lamps are now a thing of the past, and we are having increasing difficulty in obtaining repair parts, as they are no longer carried in stock by the manufacturers. They are also a very expensive lamp to keep in repair and to operate. The space this plant occupies at McPhillips street will also be required by the water works department for the new generating plant they are installing. For the above reasons I beg to advise that tenders be called for the supply of 200 enclosed arc lamps and two regulators for the extension of street lighting system during the coming year, at an estimated cost of $4,500."

SPARKS.

A charter has been granted the Georgian Bay Oil Company, Limited, of Fort Erie, Ont., with a capital of $1,000,000.

The Canadian Westinghouse Company are supplying fourteen motors, aggregating 355 horse-power, for the wood-working machinery factory of the McGregor-Gourlay Company, Galt, Ont.

The Yukon Consolidated Goldfields Company, Limited, have purchased considerable electrical apparatus from the Canadian Westinghouse Company, which they will use in connection with dredging work.

The Nairn Falls Power Company, of New Westminster, B. C., is applying for incorporation. They propose to develop a waterfall on the Nairn River, situated about 75 miles from Vancouver, where, it is believed, 50,000 horse-power is available. Among those interested are Captain P. N. Thompson, W. E. Thompson, and G. E. McDonald.

The Societe Electrometellurgique Canadien, Limited, has been incorporated in Toronto, the provisional directors including Messrs. T. H. Barton, barrister, and F. D. Byers, student. The capital is placed at $40,000.

The Winnipeg City Council are asking for tenders by February 25th for the construction of 24 miles of single track tramway between Lac du Bonnet and Point du Bois, in connection with the Point du Bois hydro-electric development.

The Schaake Machine Works, of New Westminster, B.C., are building new works, which will be operated by electric power. It has not yet been decided whether they will generate their own power or take it from the British Columbia Electric Railway Company.

The Security Light Company, Limited, has been incorporated by the Ontario Government, with a capital of $40,000, to manufacture and deal in gas, gasoline, electric or other articles and devices of a similar nature. The directors include Messrs. H. E. Pearce, capitalist, and George Bullock, traveller.

SPARKS.

The West Kootenay Power & Light Company have acquired all shares and the charter of the South Kootenay Water Power Company and will now supply power throughout the Yale district.

The Hamilton Board of Works will shortly take tenders for the supply of 500 electric arc lamps or their equivalent in Nernst or incandescent, and also for 1,000 incandescent gas lamps.

At the annual meeting of the Sherbrooke Power, Light & Heat Company, which was held recently, reports were submitted which showed the business of the company to be rapidly increasing. During the past year about $40,000 was expended in the construction of a new power house and other improvements. The following directors were elected for the ensuing year:—Hon. William White, F. P. Buck, A. G. Lomas, C. W. Cate, K.C., and M. Read.

The annual meeting of the Shawinigan Water & Power Company was held at Montreal on January 28th, when reports were presented showing the past year to have been the most successful one in the history of the company. The following officers were elected for the ensuing year:—President, Senator Mackay; Vice-President, Mr. J. E. Aldred; Directors, Messrs. John Joyce, W. R. Warren, H. H. Melville, Thos. McDougall, Denis Murphy, William Mackenzie, J. N. Greenshields; Howard Murray, Secretary.

The engineers of the Province of Nova Scotia have organized a society to be known as the Nova Scotia Society of Engineers, the objects of which are to investigate the resources of the Province and to raise the standing of the profession, as well as to bring together members of all branches of engineering. The following officers were elected at the organization meeting, which was held at Halifax on February 5th:—President, R. McColl; First Vice-President, J. H. Winfield; Second Vice-President, D. A. Freeman; Secretary, E. Brydone-Jack, Professor of Engineering Dalhousie University; Treasurer, S. Fenn; Auditors, H. W. Johnstone and J. L. Allan.

SPARKS.

Mr. John S. Fielding, C.E., 15 Toronto street, Toronto, is taking tenders up to February 29th for the construction of a concrete dam and power house for the corporation of Streetsville, Ont.

At the annual meeting of the Hamilton, Grimsby & Beamsville Railway Company, held recently, a resolution was passed authorizing the extension of the road to St. Catharines. The board of directors was re-elected.

Word has been received by Mr. James Hutchinson, president of the West India Electric Company, which is controlled by Canadian capitalists, that considerable damage was done to their plant in the recent disaster at Kingston, Jamaica.

The British Columbia Electric Railway Company have decided to install a new type of meter in all residences which they supply with electric light. The main feature of the new meter is the fact that if tampered with the current is completely cut off.

At the annual meeting of the Mexican Light & Power Company, held in Montreal recently, Mr. C. H. Cahan, general attorney, announced that at the request of Mr. E. S. Clouston he had purchased the only remaining lighting company in the Federal district of Mexico for $350,000. New plans were approved for obtaining power from the Larongo Valley.

Mr. W. A. Black, managing director of the Kaministiquia Power Company, has announced that the company intend to double the capacity of their present plant, which is 10,000 horse-power. Although the total output of the present plant has not been contracted for, it is believed that the construction of a duplicate plant and transmission line will prove a strong inducement to manufacturers to use electric power in place of steam.

The Dominion Power & Transmission Company was incorporated by the Dominion Government last month, with a capital of $25,000,000. This company have acquired a controlling interest in the Hamilton Cataract Power, Light & Traction Company. It is understood that the new company was formed for the purpose of extending some of the Cataract Company's enterprises, the latter company to remain in existence as an operating company only. The Dominion Company will have direct control of the Terminal Station Company, and will have a controlling interest in the Hamilton, Grimsby & Beamsville and Hamilton & Lancaster Railways, but may not acquire the Hamilton Street Railway. It is the intention to extend the Radial Railway to Toronto and to the Niagara frontier, and also to build lines west to Windsor. Holders of common stock in the Cataract Company receive three shares of the limited preferred stock in the Dominion Company. This stock will be preferred for five years only.

PUBLICATIONS.

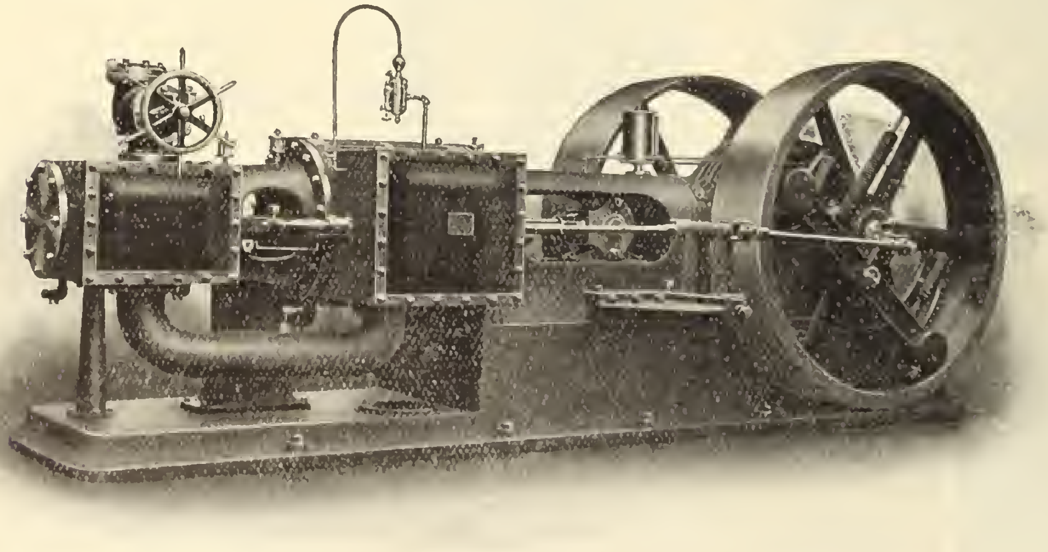
Section No. 7 of the Canadian General Electric Company's Supply Catalogue has reached our desk. It is devoted to wires and cables, and in addition to illustrations and descriptions of the materials, contains numerous useful tables.

A useful booklet entitled "Steam Specialties" has been issued by the Canada Foundry Company, Toronto. The specialties described include the Squires pressure controller or reducing valve, the Squires pilot valve pump governor, Squires steam trap, Squires feed water controller for marine and stationery boilers, and the "Easy" double tube injectors.

"Electric Ignition for Motor Vehicles," by W. Hibbert, A.M.I.E.E., has been published by Whitaker & Company, Paternoster Square, London, E.C., and Fifth avenue, New York. It contains the substance of some lectures to motormen, a chapter being devoted to each of the following: General view of the subject; batteries, computator, and coils; magnetic fields; multi-cylinder engines and synchronous ignition; faults; magneto methods of ignition.

John Wiley & Sons, 43 East 19th street, New York, have issued a new edition of "Electrical Engineering," an elementary text-book by E. Rosenberg, chief electrical engineer at Korting Bros., Hanover. The book covers a wide area. It comprises, besides the fundamental phenomena of the electric current, dynamos and motors for continuous, alternating and three phase current, then accumulators and their apparatus, measuring instruments and electric lighting. There are 350 pages and 333 illustrations. The net price is $2.

The splendid catalogue which has just been issued by the R. E. E. Pringle Company, Limited, of Montreal, is a testimony to the progress which that company have made. This catalogue, designated Number Four, is devoted to electrical apparatus and supplies, and is one of the most complete productions which has come to our notice. It consists of 480 pages, with probably 2,000 illustrations. In the front of the catalogue is shown a splendid view of their new factory building, also interior views of their various sales offices and stores. Then follows a telegraph code, after which the wide range of goods which they handle are illustrated and described, with prices. Altogether, it is a thoroughly up-to-date book of reference for electrical people.



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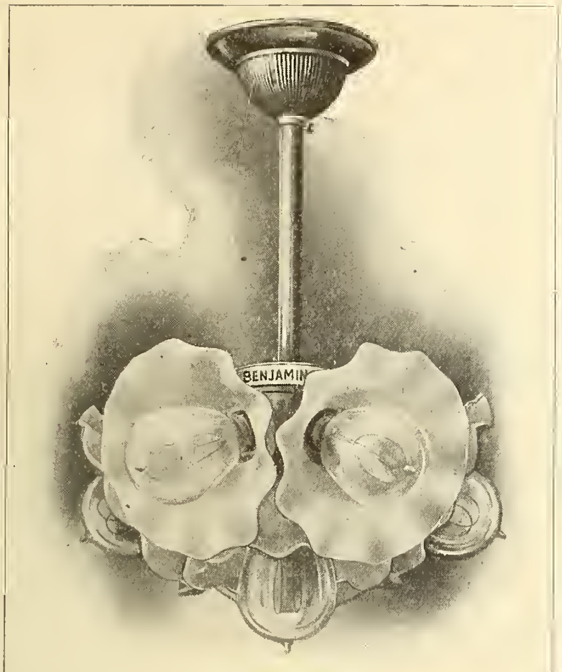
CANADIAN

Electrical News

AND ENGINEERING JOURNAL

SEVENTEENTH YEAR. No. 3. | TORONTO, MONTREAL — MARCH, 1907 — WINNIPEG, VANCOUVER | PRICE 10 CENTS $1.00 PER YEAR.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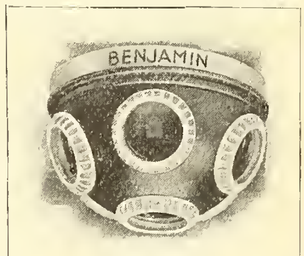
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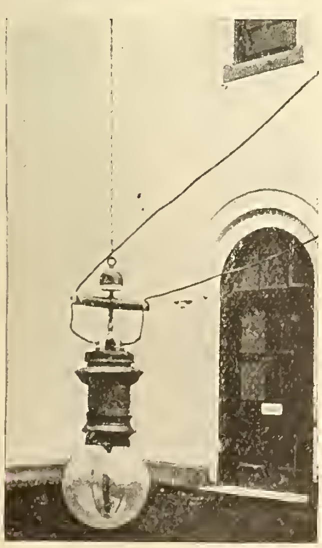


MOONLIGHT SCHEDULE FOR APRIL

Date.	Light.	Date.	Extinguish.	No. of Hours.
Apr. 1	7 00	Apr. 1	11 20	4 20
2	7 00	3	0 30	5 30
3	7 00	4	1 30	6 30
4	7 00	5	2 30	7 30
5	7 00	6	3 30	8 30
6	7 00	7	4 30	9 30
7	7 00	8	4 50	9 50
8	7 00	9	4 50	9 50
9	7 00	10	4 50	9 50
10	7 00	11	4 50	9 50
11	7 00	12	4 40	9 40
12	7 00	13	4 40	9 40
13	7 00	14	4 40	9 40
14	7 10	15	4 40	9 30
15	7 10	16	4 40	9 30
16	7 10	17	4 40	9 30
17	7 10	18	4 30	9 20
18	10 45	19	4 30	5 45
19	11 30	20	4 30	5 00
21	0 15	21	4 30	4 15
22	0 50	22	4 30	3 40
23	1 30	23	4 30	3 00
24	2 00	24	4 30	2 30
25	2 30	25	4 30	2 00
26	No Light	26	No Light	
27	No Light	27	No Light	
28	No Light	28	No Light	
29	7 20	29	10 10	2 50
30	7 20	30	11 20	4 00

Total............181 00

The Electric Controller & Supply Company, of Cleveland, Ohio, have just issued Bulletin No. 107, which is devoted to Type G controllers. This type has been designed to fulfil the conditions of crane service in industrial plants and in cases where the service is not severe enough to demand the use of their Dinkey ventilated controller.

SPARKS

The London Street Railway Company purpose building a large addition to their power house at London, Ont. Among the improvements will be the installation of a storage battery plant.

Tenders are invited by Messrs. Sinclair & Smith, engineers, New Liskeard, Ont., for furnishing and erecting two 100 horse-power three phase sixty-cycle 2,200 volt motors, with all necessary accessories, also for furnishing turbine pumps.

Park Commissioner Chambers has been authorized to dispose of the electric lighting plant at Centre Island, Toronto, it having been ascertained that a saving could be effected by contracting for the lighting of the Island with the Toronto Electric Light Company.

Canadian Engineers, Limited, have recently been incorporated, with a capital of $40,000, and have taken over the engineering practice heretofore carried on by Mr. T. T. Simpson, of Ottawa. Others interested in the company, in addition to Mr. Simpson, are Mr. W. R. Farley, C.E., and Mr. S. J. Chaplean, C.E. New offices are being fitted up in the "Brennan" building, Ottawa. The company will act as engineers in all classes of work, special attention being given to hydro-electric development.

ELECTRICAL DEVELOPEMENT COMPANY.

The report of the Electrical Development Company for the year 1906 shows that the assets of the company have increased by over $3,000,000 during the year. The investment account and other capital assets, aside from cash at the end of 1905, amounted to $11,002,275.46, which amount has now been increased to $14,253,284.07, an increase of $3,251,008.61.

Mr. Frederic Nicholls, vice-president of the company, in his report says:

"As to the future, I can only say that it is full of promise. In addition to the complete requirements of the Toronto Railway and Toronto Electric Light Company, we expect, before the end of the current year, to be supplying electric power for at least certain sections of the Toronto & York Radial Railway Company, the Niagara, St. Catharines & Toronto Railway Company, and several of our large industries. In addition, the construction of the Toronto, Niagara & Western Railway will be commenced this spring, and should be completed some time next year. This is the company that has leased the right to construct and operate a railway upon our company's right of way between Toronto and Niagara Falls, and from whom we will receive a revenue both for the use of the right of way and for the consumption of the electric power required in its operation.

"Now that the construction era of the company's history is practically at an end, except for the extension of its transmission lines, the energies of our executive will be concentrated upon the sale of power to additional consumers, and I may say here, what I have said on several occasions to the public press, viz., that we have power for sale and we intend to find a market for it. Practically our whole development for 125,000 horse-power will be completed this year, except the remaining water wheels and generators and the continuation of the power house. The head works, wheel pit, and tail race tunnels are finished for the full output, as we realize that, in order to sell this output, we must do as other traders have to do—make a price that, whilo returning a fair interest to those who have taken the unusual risks attending the inception of this enterprise, will be sufficiently attractive to command a ready sale."

Messrs. McCartney Bros., electricians, of Vancouver, B.C., have started a branch at 118 Pender street, where they are conducting a business in electric wiring and fixtures.

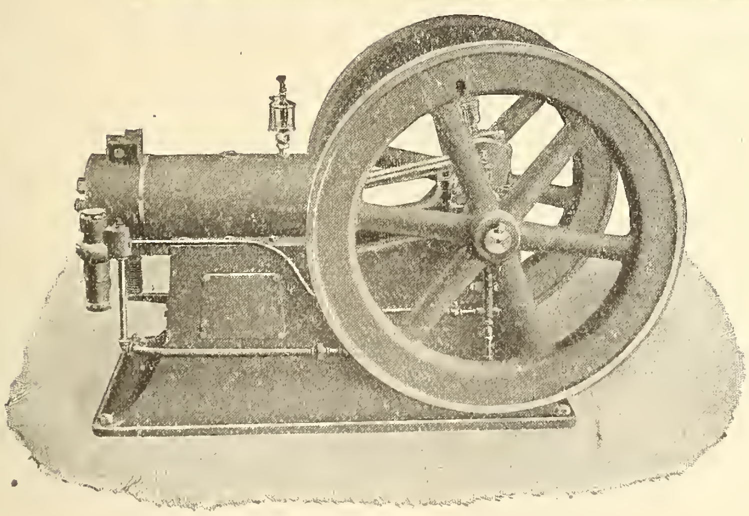
Mr. E. B. Merrill, electrical engineer in charge of the Winnipeg power development at Point du Bois, reports that good progress is being made and that tenders will shortly be invited for turbines, generators, exciters, transformers, towers for transmission lines, etc. It is probable that tenders will be obtained from Europo as well as Canada and the United States.

SPARKS.

Wetaskiwin has passed a bylaw authorizing an expenditure of $30,000 for improving and extending the municipal electric light and power plant.

Messrs. Foley, Lock & Larson have established a new electrical plant at their additional premises in Market avenue, Winnipeg. The plant consists of two 125 h.p. boilers, furnished by the Vulcan Iron Works Company, two high speed engines manufactured by A. L. Ide, Springfield, Illinois, two direct-current generators, 62½ k.w., speed 200, supplied by the Canadian Westinghouse Company. This plant supplies 32 motors used in different parts of the factory, five electric elevators and 350 continuous incandescent lights.

In tests of alcohol as fuel for internal combustion engines, a Western gas engine manufacturer has found that while a much smoother running engine is the result, owing to the higher compression possible and the slower combustion rate with alcohol, the extravagant claims for low costs of operation are not to be realized in practice. The amount of fuel consumed, under a wide range of operating conditions, was found to be practically the same per horse-power-hour as with gasolene for fuel, averaging for small units about 1 gal. per horse-power for 10 hours.



CLASSIFIED INDEX OF ADVERTISERS.

CANADIAN

ELECTRICAL NEWS

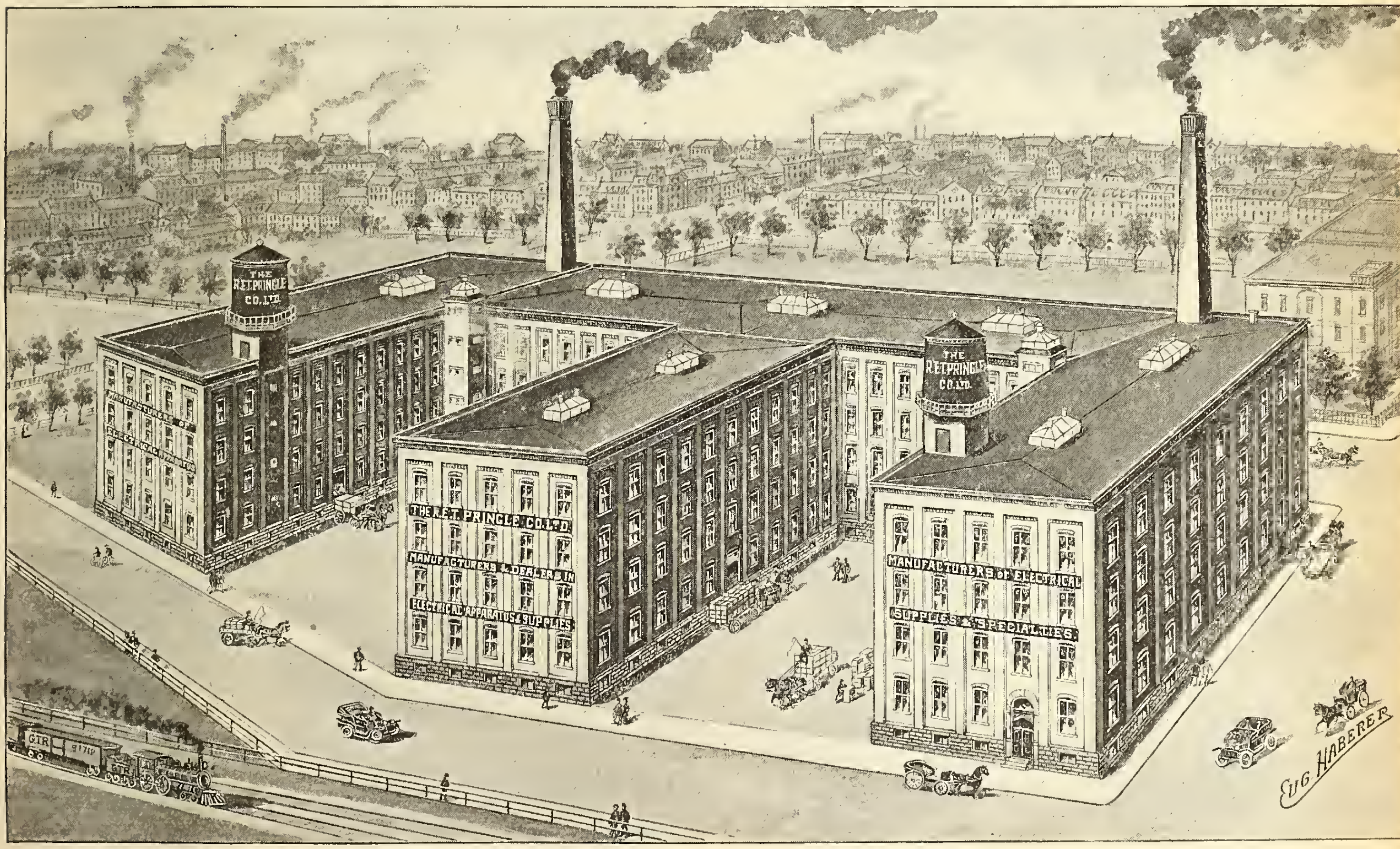
AND

ENGINEERING JOURNAL

Vol. XVII. MARCH, 1907 No. 3

New Head Office and Factory of The R. E. T. Pringle Company

The R. E. Pringle Company, Limited, was incorporated by letters patent January 30, 1902, having an authorized capital of $50,000, to acquire as a going concern the business of Mr. R. E. T. Pringle, dealer in electrical apparatus and supplies, of Montreal.



New Factory Building of the R. E. T. Pringle Company, Limited, Montreal.

In view of the largely increasing business and the constant growth of this company, the directors deemed it advisable to increase the capital to $150,000, with additional powers to enable the company to carry on an extensive manufacturing electrical business. On July 10th, 1903, supplementary letters patent were granted increasing the authorized capital to $150,000 and extending the powers of the company.

The policy of the company since its inception has been to endeavor to make prompt and complete shipments, to handle business entrusted to them with promptness and dispatch, and to devote that personal attention which is necessary for the success of the electrical supply business. To such an extent has the company met with success, that in addition to their warehouse and sales office at 16 and 18 Victoria Square, Montreal, they have branch offices and large warehouses at 62 and 64 Wellington street west, Toronto, Ont., and 105 Prince William street, St. John, N. B., and sales offices at 343 Main street, Winnipeg, Man., and in the Molson's Bank Building, Vancouver, B. C.

The R. E. T. Pringle Company's new factory and head office, located at the corner of Rose de Lima, Albert and DeLisle streets, St. Henry, and shown on this dage, has been the out come of this most remarkable growth.

With the present facilities the company will be enabled to increase the manufacture of their many well-

known specialties. They make a full and complete line of sockets and receptacles, and control the sole manufacturing rights for Canada of Harvey Hubbell, of Bridgeport, to manufacture his well-known specialties, which line in itself comprises an important feature of their business. They also control the manufacturing rights for "Fielding's" fuseless moulding rosettes and receptacles, which are meeting with a large sale throughout Canada. Standard cut-outs, rosettes, fuse plugs, wireless clusters, shade holders, etc., are but a few lines manufactured by this company, and which are made to comply with the latest regulations of the Fire Underwriters. A complete line of street fixtures for both low tension and high tension is manufactured and carried in stock. The secondary generator for bell work is another specialty manufactured and sold with great success by the company during the past few years.

The Garton Daniels Co., of Keokuk, Iowa, have also entrusted their trade to the Pringle Company, and recently they have so perfected their lightning arresters that they are able to compete for high voltage work with marked success.

Incandescent lamps under the trade label of "Buckeye" have been sold by this company for many years, in addition to many other lines which cannot here be mentioned. They have the sole Canadian agency for the Adams-Bagnall Electric Company, Cleveland, who manufacture arc lamps for all circuits. This lamp has become a recognized standard in arc lighting.

To return to the manufacturing end, an important branch is their switchboard and panel board business, in connection with which they have undertaken the manufacture of material incidental to switchboard work, such as knife switches, copper bus bar work, etc.

The company have also commenced the manufacture of the "Pettingell-Andrews" open circuit protector, which is a device used largely on series alternating arc light systems.

The head office of the R. E. T. Pringle Company, Limited, is situated at the factory, where will be found Mr. R. E. T. Pringle, managing director and treasurer, to whose untiring personal attention the success of the company is largely due. Mr. I. H. Smith is general sales manager for the company and gives his personal attention to the Montreal district, which comprises the Province of Quebec and the main line of the Grand Trunk east of Kingston, Ont., and extending north on the Ottawa as far as Pembroke. Mr. George Leroux, secretary of the company, has charge of the accounting end.

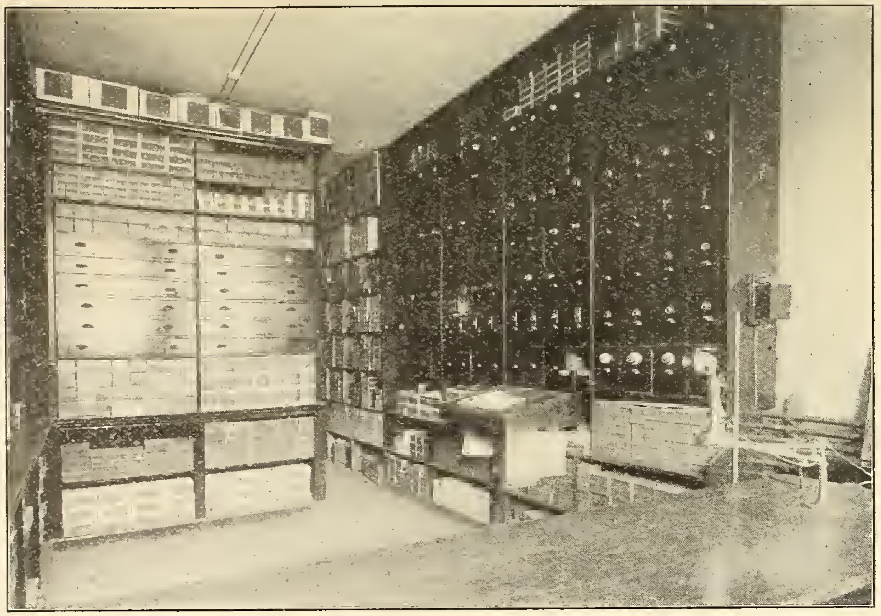
The warehouse and office in Toronto is under the management of Mr. A. Esling, whose district extends from Kingston west to Sault Ste. Marie. Mr. E. H. Smith, who was for many years manager of the St. John office, now has charge of the Winnipeg office, his territory including from Port Arthur, Ont., to the Rockies. The Province of British Columbia is in charge of Messrs. Bayfield & Archibald, Mr. Archibald devoting his special attention to the business. The business of the Maritime Provinces is in the hands of Mr. W. W. Bogart, whose headquarters are at St. John, N.B. At the St. John office, in addition to carrying a complete line of supplies, they make a specialty of electric fixtures and glassware, having fitted up elaborate show-rooms for the sale of these goods.

The R. E. T. Pringle Company extend a cordial invitation to the electrical fraternity to visit their large new factory and offices in Montreal, as well as their show-rooms in other cities.

INTERIOR OF R. E. T. PRINGLE COMPANY'S ST. JOHN STORE, 105 PRINCE WILLIAM STREET.

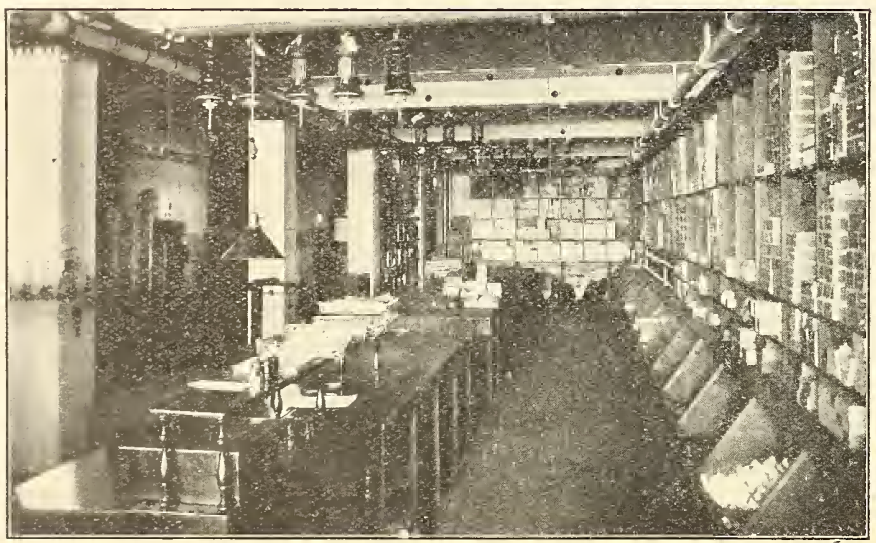
Mr. Junge says that the most economical way of reducing heat losses through the exhaust is by utilizing the same for raising steam in an exhaust boiler. As high as 160 pounds per square inch can in this way be generated, and used for heating and other purposes. Generally 10 per cent. or more of the total output can be recovered from the exhaust of gas engines.

Progress in the large gas engine industry is indicated by the following figures: In Great Britain there are now built or building 119 large engines, with a total indicated horse power of 96,000; in Germany, 380 engines, with a horsepower of 421,150; in Belgium, 55 engines, with a total of 61,400 horsepower. Perhaps the largest unit yet built is the 5,000-horsepower engine by Messrs. Erhardt and Sehmer, of Germany, which has four cylinders 45.25x51.25 inches, running at 90 revolutions a minute.

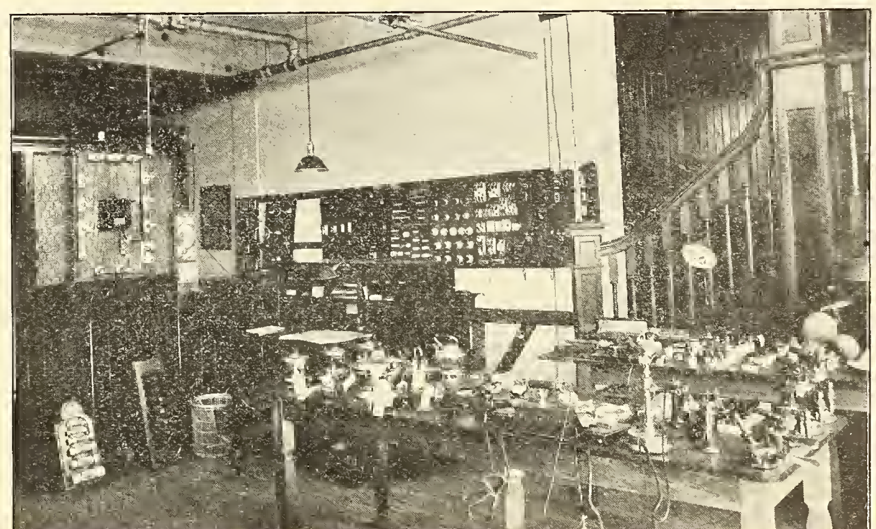


Store, 16-18 Victoria Square, Montreal.

Sales Office, 16-18 Victoria Square, Montreal.



Store, 62-64 Wellington Street, Toronto.



Sales Office, 62-64 Wellington Street, Toronto.

SALES OFFICES AND STORES OF THE R. E. T. PRINGLE COMPANY, LIMITED.

THE ELECTRICITY INSPECTION ACT

A new Act has received its second reading in the Dominion Parliament, to be known as "The Electricity Inspection Act," and by which the existing Electric Light Inspection Act is to be repealed. It contains a number of changes from the old Act, and is evidently intended to provide for the inspection of meters for the supply of power as well as light. In some respects the new law will be a disappointment to electrical companies, inasmuch as inadequate provision is made to prevent the theft of electric current. As things stand at present it is almost impossible to secure a conviction, and we believe the stealing of current is on the increase. The clause covering this point is no better than the old one.

The full text of the new Act is given herewith, although amendments may be made before it passes the House. We invite a free discussion of it in the columns of The Electrical News:—

SHORT TITLE.

1. This Act may be cited as The Electricity Inspection Act, 1907.

INTERPRETATION.

2. In this Act, unless the context otherwise requires,—

(a) "Contractor" means any person undertaking to furnish electricity to any purchaser for lighting or other purposes.

(b) "Purchaser" means any person to whom electricity is furnished.

(c) "Meter" means an electric meter, and includes every kind of machine, apparatus, or instrument used for measuring the quantity of electrical energy or pressure furnished to the purchaser.

(d) "Purchaser's terminals" means the ends of the electric lines or conductors situate upon the purchaser's premises at which the supply of electricity is delivered from the service lines.

(e) "Department" means the Department of Inland Revenue.

(f) "Minister" means the Minister of Inland Revenue.

(g) "Inspector" means an inspector appointed under this Act by the Department.

UNIT OF SUPPLY.

3. The commercial unit of supply of electrical equivalent thereof in ampere-hours.

DUTIES AND RIGHTS OF CONTRACTOR.

4. Before commencing to give a supply of electrical energy to any purchaser, the contractor shall declare to such purchaser the constant pressure at which he proposes to supply energy at the purchaser's terminals.

(2) The variation of pressure at any purchaser's terminals shall not under any conditions of the supply which the purchaser is entitled to receive, nor at any time, exceed three per cent. from the declared constant pressure, whether such variation is due to the resistance of the service lines or apparatus belonging to the contractor, or to any action or effect produced by such apparatus, for which the purchaser cannot be shown to be responsible, or partly to a variation of pressure in the distributing mains from which the supply is taken.

(3) The contractor shall not be liable for any variation of pressure caused by unavoidable accident to the generating plant or apparatus, or by the uncontrollable condition of the elements.

5. The contractor shall be responsible for all electric lines, fittings and apparatus, belonging to him or under his control upon the purchaser's premises, being maintained in a proper condition, and in all respects fit for supplying energy; but he shall not be responsible for any damages arising from the use of the electric current in lines, fittings and apparatus not belonging to him or under his control.

6. If the contractor is reasonably satisfied, after making all proper examination by testing or otherwise, that at some part of a circuit a connection with the earth exists of such resistance as to be a source of danger, and that such connection does not exist at any part of the circuit belonging to the contractor, any officer of the contractor, duly authorized by him in writing, may, for the purpose of discovering whether such connection with the earth exists at any part of the wires upon any purchaser's premises, at all reasonable times, after giving one hour's notice of his intention to do so, enter such premises and disconnect the purchaser's wires from the service lines, and may require the purchaser to permit him to inspect and test the wires and fittings belonging to the purchaser and forming part of the circuit.

7. If, on such inspection and testing, the officer discovers that a connection exists between the purchaser's wires and the earth, and that such connection has an electrical resistance of less than five thousand ohms., or if the purchaser does not give all due facilities for such inspection and testing, the contractor shall forthwith discontinue the supply of energy to his premises, giving immediate notice of such discontinuance to the purchaser, and shall not recommence such supply until he is satisfied that such connection with the earth has been removed.

8. If any purchaser is dissatisfied with the action of the contractor, either as to the mode of making the test or in discontinuing the supply of electricity to his premises, the wires and fittings of such purchaser may, on his application to the Department, be tested, for the existence of such connection with the earth, by an inspector.

9. Any officer of the contractors authorized in writing by the inspector may, for the purpose of,—

(a) inspecting their electric wires, meters, accumulators, fittings, works, and apparatus for the supply of electricity; or,

(b) ascertaining the quantity of electricity consumed or supplied; or,

(c) removing any electric lines, accumulators, fittings, works and apparatus belonging to the contractors, in cases where a supply of electricity is no longer required or the contractors are authorized to take away and cut off the supply of electricity from any premises;

(d) enter at all times any premises to which electricity is or has been supplied by the contractors.

(2) Such officer shall repair all damage caused by such entry, inspection or removal.

10. Before supplying electricity to purchasers, the

contractor shall obtain from the Department, or from an officer appointed for the purpose, a certificate of registration for every generating plant owned or operated by the contractor in any city, town, village or other municipality, and shall pay the officer issuing such certificate the fees prescribed by the Governor in Council.

(2) Such certificate shall expire on the thirty-first day of March in each year, and shall be renewable from year to year.

INSPECTORS.

11. Any person may, after examination as to his qualification, be appointed and may act as an inspector under this Act.

(2) No inspector shall be a seller of electricity or electric meters, or be employed by any person or company supplying electricity or meters.

(3) No inspector shall repair or adjust any meter inspected or verified by him.

METERS.

12. The amount of electrical energy supplied by a contractor to any purchaser under this Act, or the electrical quantity contained in such supply, shall, if the purchaser so desires, be ascertained by means of a suitable meter, duly certified in accordance with regulations established under the authority of this Act.

(2) Whenever a reading of a meter is taken by the contractor for the purpose of establishing a charge upon the purchaser, the contractor shall cause a duplicate of such reading to be left with the purchaser.

13. No meter shall be fixed for use which has not been verified and stamped as hereinbefore provided.

(2) No meter, after it has been fixed for use, shall be verified or stamped by any person except by the inspector as herein provided.

14. No meter shall be fixed for use unless it plainly indicates by means of suitable dials the amount of current or energy passing to the purchaser's wires.

(2) Every meter fixed for use shall have the maker's number, the maximum current in amperes, the limits of pressure, and, if for alternating currents, the limit of frequency of alterations, legibly stamped or engraved on the case or dial.

15. No meter shall be stamped which is found by the inspector to register quantities varying from the legal standard unit of electricity more than three per cent. in favour of either the contractor or the purchaser.

16. The verification of each meter shall be attested by affixing or impressing, on some essential part thereof, a stamp or mark of such description and in such manner as is directed by regulations made by the Minister.

17. Within twelve months after the expiration of five years from such verification and stamping, every meter shall again be verified and stamped.

18. No meter duly stamped as aforesaid shall be liable to be re-verified or re-stamped within a period of five years from the then last verification or re-verification thereof, although it is used in any other place than that at which it was originally stamped, but shall be considered as a lawful meter throughout Canada, unless found incorrect under this Act, or requiring re-verification by lapse of time as aforesaid.

(2) The purchaser or the contractor may, at any time, at the cost of the party in fault, require the verification of the meter used.

(3) In the event of an inspected meter being found, on re-inspection, to vary from the standard, the contractor or the purchaser, as the case may be, shall only be entitled, in estimating any rebate, to the gain or loss, as the case may be, which has taken place during the three months immediately prior to such re-inspection.

19. Every purchaser may own and use, for determining the amount of electrical energy consumed, any meter which has been verified and stamped as aforesaid.

20. In every case the owner shall keep the meter in good repair, and shall be responsible for the due inspection and testing thereof, and, except as herein otherwise provided, shall pay the fee lawfully chargeable for such inspection, and shall be liable for all penalties incurred with respect to such meter.

21. The verification and testing of meters shall be performed in accordance with the provisions of this Act and with such further regulations, not inconsistent therewith, as are made by the Minister.

22. The contractor shall provide electricity and wiring and all other reasonable facilities for testing, free of charge, at such places as are agreed upon between the contractor and the Department.

23. If any dispute arises between the contractor and the purchaser or between the contractor and the inspector, respecting the correctness of such meter, the inspector shall, if required by any person dissatisfied, refer such dispute to the Department for final decision.

(2) During the testing of any disputed meter, the contractor or purchaser may be present, by himself or his agent authorized in writing; and twenty-four hours' notice of the test shall be given by the inspector to both the parties interested.

GENERAL.

24. The purchaser may at any time, on payment of a fee to be fixed by the Governor in Council, call on an inspector to test the pressure of the electricity supplied by the contractor, and to furnish a certificate thereof.

25. The inspector shall give to either the contractor or the purchaser, or to both, on payment of the proper fee, a certificate stating the result of his test, and the time at which it was made, and at whose instance, and any other particulars he thinks right to insert for the information and guidance of the persons concerned.

(2) Such certificate shall be prima facie evidence of the condition of the meter or electrical pressure tested, and when more such certificates than one are issued, the proper fee shall be paid upon each certificate.

26. The contractor shall at all times keep in his office, in a book or books, the names and addresses of purchasers for the time being—which book or books shall be open to the inspector during office hours, and from which he may take such extracts as he thinks fit.

27. The fees for the inspection and testing of purchasers' wires and the testing of lamps and meters shall be determined from time to time by the Governor in Council and published in The Canada Gazette, and such fees shall be regulated so that they will, as nearly

as may be, meet the cost of carrying this Act into effect; and all fees received under this Act shall be accounted for and paid to the Minister of Finance and Receiver-General and in such manner as the Minister directs, and shall form part of the Consolidated Revenue Fund of Canada.

28. The Governor in Council may from time to time direct stamps to be prepared for the purposes of this Act, bearing such device as he thinks proper, and may defray the cost thereof out of any unappropriated moneys forming part of the Consolidated Revenue Fund of Canada.

(2) The device on such stamps shall express the value thereof, that is to say, the sum at which they shall be reckoned in payment of the fees hereby prescribed.

29. Separate accounts shall be kept of all expenditures incurred and of all fees and duties collected and received under the authority of this Act; and a correct statement thereof, up to the thirty-first day of March then last past, shall be yearly laid before Parliament within the first fifteen days of the then next session thereof.

OFFENCES AND PENALTIES.

30. Every contractor who makes default in complying with any requirement, as to supply, of sections 4 to 10, both inclusive, of this Act, shall be liable for every such default to a penalty not exceeding twenty dollars for every day during which such default continues.

31. Every contractor who fails at any time to keep in his office in a book or books the names and addresses of the purchasers for the time being open to an inspector during office hours, from which the inspector may take such extracts as he thinks fit, shall incur a penalty of fifty dollars.

32. Every person who, except under the authority of this Act, makes, causes or procures to be made, or knowingly acts or assists in making, or who forges or counterfeits, or causes or procures to be forged or counterfeited, or knowingly acts or assists in the forging or counterfeiting any stamp or mark used for the stamping or marking of any meter under this Act, shall incur a penalty not exceeding two hundred dollars and not less than fifty dollars.

(2) Every person who knowingly sells, utters or disposes of, lets, lends or exposes for sale, any meter with such forged stamp or mark thereon, shall, for every such offence, incur a penalty not exceeding two hundred dollars and not less than twenty dollars;

(3) All meters having on them such forged or counterfeited stamps or marks shall be forfeited and destroyed.

33. Every person who knowingly repairs or alters, or causes to be repaired or altered, or knowingly tampers with or does any other act in relation to any stamped meter or to the wires leading to the meter so as to cause such meter to register wrongly, or who prevents, or refuses lawful access to any meter in his possession or control, or obstructs or hinders any inspection or testing authorized by this Act, shall incur a penalty not exceeding one hundred dollars and not less than fifty dollars, and shall pay the fees for removing and testing, and the expense of purchasing and fixing a new meter.

(2) The payment of any such penalty shall not exempt the person paying it from liability to indictment or other proceeding to which he would otherwise be liable, or deprive any other person of the right to recover damages against such person for any loss or injury sustained by such act or default.

34. Every person who fixes for use, or causes to be fixed for use, any meter, before it has been verified and stamped as herein required, shall incur a penalty of twenty-five dollars for every such unverified or unstamped meter.

35. Every person, other than the inspector, who, when the accuracy of any meter which has been verified and sealed under this Act is in dispute, wilfully breaks or causes to be broken the seal of that meter, shall incur a penalty of twenty-five dollars for every such offence.

(2) The contractor, however, after giving the purchaser twenty-four hours' notice, in writing, of his intention so to do, may break the seal of an undisputed meter when it is found necessary to disconnect such meter for readjustment or repairs.

36. Every inspector who stamps any meter without duly testing and finding it correct, or who refuses or neglects, without lawful excuse, for three days after being required under the provisions of this Act, to test any meter, or to stamp any meter found correct on being so tested, or who neglects to perform any duty imposed upon him by this Act, or by any regulations made under the authority thereof, shall incur a penalty not exceeding fifty dollars and not less than ten dollars, and shall be liable to dismissal from office.

37. Every person, except the inspector as herein provided, who verifies or stamps, or causes to be verified or stamped, or who issues a certificate as to the accuracy or condition of any meter after it has been fixed for use, shall incur a penalty of twenty-five dollars for every meter so verified.

38. Every person who violates any of the provisions of this Act, or of any regulations established under this Act, or who neglects any duty imposed on him by this Act, or by any such regulation, for which violation or neglect no penalty is specially herein provided, shall incur a penalty of not more than one hundred dollars.

PROCEDURE.

39. All penalties imposed by this Act or by any regulations made thereunder shall be recoverable on summary conviction with costs,—

(a) if the penalty does not exceed twenty dollars, before any justice of the peace for the district, county or place in which the offence was committed; and,

(b) if the penalty exceeds twenty dollars, before any two justices of the peace.

(2) Such penalties may, if not forthwith paid, be levied by warrant under the hand and seal of the convicting justices, who may award any imprisonment to which the offender is liable.

(3) When the offender is a corporation any process or other paper required by Part XV. of the Criminal Code to be served upon the defendant in proceedings under that part may in such case be served upon the mayor, or chief officer of such corporation, or upon the clerk or secretary thereof.

40. No action or prosecution shall be brought against any person for any fine or penalty under

this Act, unless it is commenced within six months after the offence is committed.

REGULATIONS.

41. The Governor in Council may establish rules and regulations—

(a) for the testing of electric light lamps for illuminating power;

(b) for instituting tests to determine what style or make of meter shall be used to measure the quantity of electrical energy supplied;

(c) for determining a standard or standards for arc lighting; and

(d) such other regulations, not inconsistent with this Act, as are necessary for giving effect to its provisions and for declaring its true intent and meaning in all cases of doubt.

REPEAL.

42. The Electric Light Inspection Act, chapter 88 of The Revised Statutes, 1906, is hereby repealed.

HIGH TENSION TRANSMISSION.

The results of experiments by E. Jona in the handling and transmission of currents of exceptionally high pressures have been published in a recent issue of L'Industrie Electrique. The supply source consisted of a 150 kw. transformer having a primary wound for 160 volts, and having two sets of secondary coils each giving a pressure of 160,000 volts; therefore with the secondaries in series a tension of 320,000 volts was available. The voltages were measured by an electrostatic volmeter, which read up to 200,000 volts; for the higher readings this instrument was connected across only one of the secondaries. Tests were made on a cable 400 feet long and consisting of a nineteen-strand core about 18mm. in diameter, insulated with successive layers of rubber and paper up to a diameter of 48mm., the whole being lead-covered. This cable, in the form of two coils, was connected to the transformer and used as the two lines of a transmission system at 160,000 volts, the current being used to light a number of vacuum tubes. Samples of this cable were tested by means of the transformer for the breakdown voltage. Lengths of from 15 feet to 20 feet in length were prepared by stripping back the lead sheathing and covering the exposed insulation with resin and porcelain tubes. The terminals of the transformer were then connected to the remaining portion of the lead sheating and the core, and the voltage increased until the dielectric was perforated. This occurred for three samples at 208,000, 202,000, and 210,000 volts respectively. Other tests were made of a high-tension cable recently constructed for a 13,000 volt three-phase circuit laid on the bottom of Lake Garde. The circuit consists of three single-core cables. The conductor is stranded, and has an equivalent cross section of 75 square mm. This is insulated by layers of rubber 5mm. thick and gutta percha 1.2mm. thick. This is then covered by a lead sheathing, followed by a layer of jute and an armour of fifteen steel wires covered by a jute wrapping. The samples of this cable used in the tests were 9 feet long, and they withstood successfully a tension of 100,000 volts, which was the maximum that could be applied on account of the violent sparking which took place from the steel armour along over the surface of the insulation to the core.

The transformer was also used for experiments with an overhead line carried on large porcelain insulators. Two thicknesses of wire were used, one 70mm., which gave brush discharges at 50,000 volts, and another, 100mm. in section, showed the same phenomenon at 100,000 volts. The pressure in the latter case was increased up to 280,000 volts, at which point the discharge was brilliant, and flashes took place across the line and over the insulators.

Another interesting experiment consisted in applying the voltage of 90,000 to a spark gap about 10 in. long. The latter was mounted on the axle of a small induction motor driven by the same supply. When the circuit was closed sharp discharges took place between the terminals, which were quickly put out, due to their motion. The result was a series of discharges having the appearance of a sort of cage revolving slowly in a direction opposite to the rotation of the motor, and at a speed approximately equal to its slip.

SWITCH BOXES.

Some people seem to find it hard to understand why push type switches must be enclosed in iron boxes, when used on concealed knob and tub work. There are three good reasons of about equal importance. In most cases the switch is more or less exposed to falling plaster, dirt, etc. The box offers a boxes, when used on concealed knob and tube work. is apt to be exposed to mechanical injury during the completion of the building, against which the box also offers protection. All such switches are liable to break down under operating conditions with resulting heating and arcing. The box helps to confine this incipient fire where it will do little harm. —Electrocraft.

SUNBEAM TUNGSTEN LAMPS.

Experiments are now being conducted by the engineering department of the Sunbeam Incandescent Lamp Company, on tungsten metallic filaments, and as a result of recent developments the Western Electric Company reports that it will, no doubt, be among the first of the companies which will be in position to furnish these lamps to the trade. This is an eighty-candle-power lamp, with a total wattage of 100, or one and one-fourth watts per candle-power. The lamp is not yet offered for sale.

BALANCING OF A THREE-PHASE LIGHTING SYSTEM.

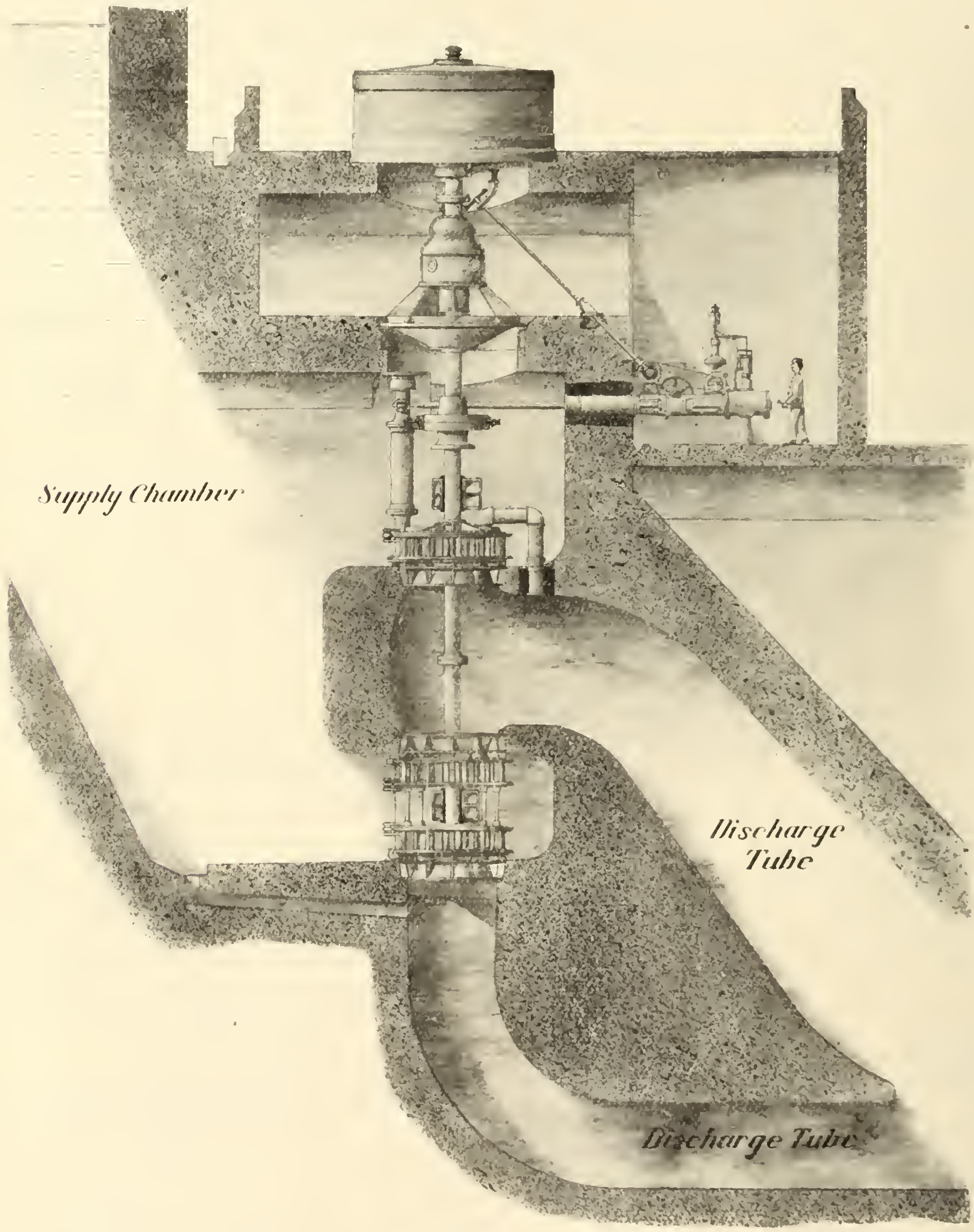
There is often great difficulty in keeping a low-voltage three-phase system in balance on a lighting load, due to the fact that the individual lamps are turned on and off at irregular intervals. The following scheme, described by J. A. Corcoran in the Electrical World, permits great flexibility of control at the switchboard, allowing each feeder to be readily thrown on any phase. The scheme is to use two single-pole double-throw switches. The middle of each switch is connected to a feeder circuit, and by throwing over one or other of the switches the circuit may be connected to any one of the three phases, as one main is connected to both bottom contacts and the other two to one of each of the top contacts respectively. This is a great improvement on the ordinary method of using a double-pole double-throw switch, which only allows the load to be taken from either of two phases.

8,000 H.P. Turbines for the West Kootenay Power and Light Company

On May 27, 1905, the West Kootenay Power & Light Company, Limited, of Rossland, British Columbia, awarded to the I. P. Morris Company, of Philadelphia, the contract to design, construct and deliver and superintend the erection of two 8,000 horse power vertical shaft turbine units, two 300 horse power vertical shaft exciter turbines and four Glocker-White governors, also all the miscellaneous apparatus necessary for a complete installation in the power house located on the Kootenay river above Bonnington Falls.

On January 1, 1907, the installation of these wheels was practically completed and the turbines were started in operation.

Each main unit is capable of delivering to its electrical generator 8,000 mechanical horse power when operating under a head of 70 feet of water and when running at a speed of 180 revolutions per minute. The quantity of water required per unit is 1260 cubic feet per second, or a volume equal to the flow of a river 100 feet wide, five feet deep and moving with a velocity of 151.2 feet per minute.



General Arrangement of 8,000 H. P. Turbine Unit for the West Kootenay Power and Light Company.

The general arrangement of one of the main units is shown in the illustration.

Each 8,000 h.p. turbine consists of three inward flow Francis runners mounted on a vertical shaft, each runner being equipped with its own distributor and movable guide vanes. These distributors are bolted to heavy cast iron base rings secured to the masonry. The runners are thus mounted in concrete pits which form the turbine wheel casings and the draft tubes for carrying the discharge water to the tail race.

The runners are made of special turbine metal of approximately 88 parts copper, 10 parts tin and 2 parts zinc. Each is made in one piece, cast in cores and bolted to the hub. The hubs are made by enlarging the shaft at the points where the runners are attached, and heavy flanges are turned on the shaft above the hubs, to which the runners are securely bolted.

The upper and intermediate runners discharge in opposite directions into a common draft tube, the upper one discharging downward. The lower runner like the upper one discharges downward also, but into its own individual draft tube. The chamber above the upper runner is by-passed to the draft tube, which relieves the pressure in the chamber, and thus eliminates the hydraulic thrust of this runner. As the other two runners discharge in opposite directions, the total resultant thrust on the shaft is theoretically zero. The thrust bearing, however, has been designed to take care of a generous amount of thrust over and above the dead weight of the revolving parts. The revolving parts consist of the rotor of the generator, the shaft in three sections, three runners weighing 4000 pounds each, couplings and bolts, making a total of 170,000 pounds. The thrust bearing consists of two specially close grained cast iron disks. The lower disk is supported by a ball seat, while the upper is securely held in place by an adjusting nut on shaft. The disks have raised lips on the outside and inside circumferences, so as to form an annular pressure chamber, into which the oil is forced under a pressure of 250 pounds, which lifts the revolving parts. When these parts are lifted the oil escapes between the surfaces of the disks, by this means supporting the total weight on a film of oil.

The thrust bearing is covered with a neat cover, fitted with glass peep holes. The oil is supplied to the bearing from a high pressure triplex pump, capable of working under a pressure of 500 pounds per square inch. This pump is directly driven from the main turbine shaft by bevel gearing and counter shaft. Each turbine has its own pump, oil tank, piping, guages, etc., which in fact is a complete system in itself, independent of the governor system.

An extra motor driven pump with piping has been provided which is arranged to act as a spare for any one of the main units or exciters, but its primary use is to supply oil to the turbines when starting up.

The main turbine shaft is kept in alignment by three guide bearings. The upper guide bearing is built in conjunction with the thrust bearing. It is lined with Parsons' white brass and is lubricated by oil supplied under pressure.

The intermediate and lower guide bearings, the former situated above the upper runner and the latter between the intermediate and lower runners, are lignum vitae bearings, made by driving lignum vitae into the dovetail spaces in the bronze boxes. As these bearings are submerged they are well lubricated with water and require little or no attention.

The water is distributed to the runners through malleable iron movable guide vanes finished smooth, so as to offer little resistance to the water. These vanes are operated by means of links from one side of vane. The links are connected up to the vane operating ring. The rings are operated by rods and levers from a vertical shaft, which shaft leads to the operating deck where the governor is located.

The revolving balls of the governor control a pilot valve attached to an equalizing lever. This valve operates a relay valve which in turn controls the main operating piston, which is connected to the vane operating shaft.

An oil pump, a pressure tank and the necessary piping is furnished with each governor.

In order to control the speed of the turbines from the switch board each governor is furnished with remote electrical control.

The upper two sections of the main turbine shafting are joined together by a cast steel coupling four feet in diameter. The brake mechanism is fitted about the coupling, the outer edges forming the brake band. Two brake shoes are applied on the brake band, and a hand mechanism is arranged so that a force of 10,000 pounds is brought on each brake shoe.

Each turbine is guaranteed to give an efficiency of at least eighty (80) per cent when delivering 8000 horse power and when operating under a head of 70 feet and running at a speed of 180 revolutions per minute.

WATER PUMPING BY CENTRAL STATIONS.

The pumping of water for the waterworks system of a small town by the Central Station Company is a class of business which has been undertaken by a number of small central stations. If the contract is obtained at a reasonable rate, the business should prove a most satisfactory source of income, especially where the water system has a standpipe or elevated reservoir of some kind for the storage of water, so that it is not necessary to operate the waterworks pumping machinery during the peak of the lighting load. Of course, there are a number of combined waterworks and electric light plants where the pumping is done by steam obtained from a single set of boilers. In the majority of cases the waterworks plant is already built separate from the lighting plant, so that it is a problem of installing electrically-driven pumps operated from the electric station, if the Central Station Company takes over the pumping of water for the waterworks. The apparatus necessary to pump water for a waterworks system by means of electric motors, of course, depends largely on the source of water supply and the presence or absence of auxiliary storage in the shape of a standpipe or elevated tank. Geared or belted plunger pumps driven by motors have heretofore been most commonly employed in this work, but the centrifugal pump is now beginning to enter the field. An interesting application of centrifugal pumps to waterworks pumping is described in an article in this issue on the La Grange, Ill., pumping plant. The plant contains several novel features. One of these is the use of a vertical shaft centrifugal pump 80 feet below the surface, placed in a drilled well which was enlarged to 15 inches at the top to accommodate a centrifugal pump of small diameter. Another interesting feature is the use of centrifugal pumps which can be operated either in multiple for pumping into the standpipe or in series for giving an increased direct pressure in the mains in times of fire. Centrifugal pumps of the type used at La Grange with vertical shafts, and with the pump proper placed at or below water level in the well, have been used in much shallower and larger wells to a considerable extent in pumping for irrigation purposes in California. Their application to a well only 15 inches in diameter is interesting, and it will be still more interesting to see in the next few years how much of a part centrifugal pumps of this type will play in deep well pumping. —Electrical World.

THE 1907 CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the Executive Committee of the Canadian Electrical Association was held in Toronto on March 13th, at which it was decided to hold the next annual convention in Montreal concurrently with the proposed Electrical Exhibition. This Exhibition will take place in the early part of September and the exact dates of the convention will be announced later.

Mr. A. A. Dion has again undertaken to act as Editor of the Question Box which he has so ably conducted for some years. This work demands much time and thought on his part, really more than he should be expected to give. His labors, however, would be greatly lightened if every member of the Association would co-operate by sending in questions and answers. The questions so far have come in slowly. Let everyone who reads this announcement consider it a command to forward at least one question to Mr. Dion, and also to give as much assisance as possible by furnishing answers. Resolve to support the Question Box and make the 1907 edition the biggest and best yet.

DR. BARNES PROFESSOR OF PHYSICS.

The Board of Governors of McGill University have appointed Dr. Howard T. Barnes, D.Sc., F.R.S.C., associate professor of physics, to the chair in the Faculty of Applied Science, presently to be vacated by Prof. Ernest Rutherford.

The appointment of Dr. Barnes will be considered a distinguished honor to the general body of Canadian scientists, and more particularly to those who have claimed McGill as their alma mater. The new professor of physics will succeed to a position held in recent years by two men whose services to science have been recognized the world over, Prof. Callendar, whose success in the realm of physical research won him the important appointment of professor of physics in University College, London, and Prof. Rutherford, whose brilliant development of the nature of radio-activity has set him in the fore-front of the world's physicists and within the last few months brought him the offer of one of the most important scientific appointments in Great Britain. It is through the acceptance of this offer that the chair of physics at McGill becomes vacant, Dr. Rutherford's engagement with McGill coming to an end at the close of the present session.

While not a Canadian by birth, Dr. Barnes is one by upbringing and education, being the son of Rev. W. S. Barnes, minister of the Church of Messiah, and long a resident of Montreal. Dr. Barnes was born at Woburn, near Boston, the birth place of Count Rumford, whose fame as a scientist has been perpetuated through the founding of the Rumford Medal, awarded, by the way, in 1904, to the man whom Dr. Barnes will succeed—Dr. Rutherford.

After an early education under the guidance of Rev. John Williamson, Dr. Barnes entered the faculty of applied science at McGill, graduating with the bachelor's degree in 1893, while still under his twentieth year. From 1893 to 1898 he continued his studies at McGill, alternating these with work as demonstrator in the physics building. In 1897 he obtained his master's degree. In this year Dr. Barnes was awarded the Joule studentship of the Royal Society of London—the first awarded to any Canadian scientist. This studentship gave him opportunity for the next two years to continue the research work in heat, which had first won him the recognition of the famous old English scientific body. In 1900, after obtaining the degree of Doctor of Science he went to England and submitted in a paper the results of his work. On his return to Montreal he was appointed lecturer in physics. In 1902 he became assistant professor of physics, and in 1906 accociate professor.

Dr. Barnes has become one of the chief authorities on certain branches of physics. His researches, entending over several years, on the specific heat of water, have become a classic, and after occupying the attention of the Royal Society of London at a special season, were made the basis of the report on this subject to the conference of physicists at the last Paris Exhibition. His work on "Ice Formation and Frazil," on which he has recently published the first authoritative book, has important bearings on the utilization of water powers in northern countries, such as Canada and Russia; and his recording thermometers are coming into use in the regulation of furnaces and other branches of manufacture.

Dr. H. T. Barnes,
Professor of Applied Science, McGill University.

On account of the largely increased trade, the Midland Electric Company have secured more commodious warehouses, situated at 119 and 121 D'Youville Square, which they will occupy on the 1st of May.

A big illuminated sign contaning the words "City Hall" has been placed in position over the entrance to the municipal building in New Westminster, B. C. The sign will be illuminated on the nights when the Council is sitting. The Council themselves have set the pace for electric signs in that city, and doubtless many of the merchants will follow their lead.

The Stave Lake Power Company, of Vancouver, has recently applied for one of the largest water records posted in the Mining Records Office in New Westminster, B. C. The application is for 75,000 inches. Only on one previous occasion has such a large record been granted, that being on the 15th of January, 1900, and was equal to the one they are at present receiving. The cost of the record will be a little over $4,000.00, while the yearly license will amount to about $1,500 00. A peculiar feature of the case is that the water for which the record is now being sought is really the same as is at present being used by the company. The water is diverted from the river at a point above that at which the record is now wanted and returned to the river, and will be used again immediatly the record is granted.

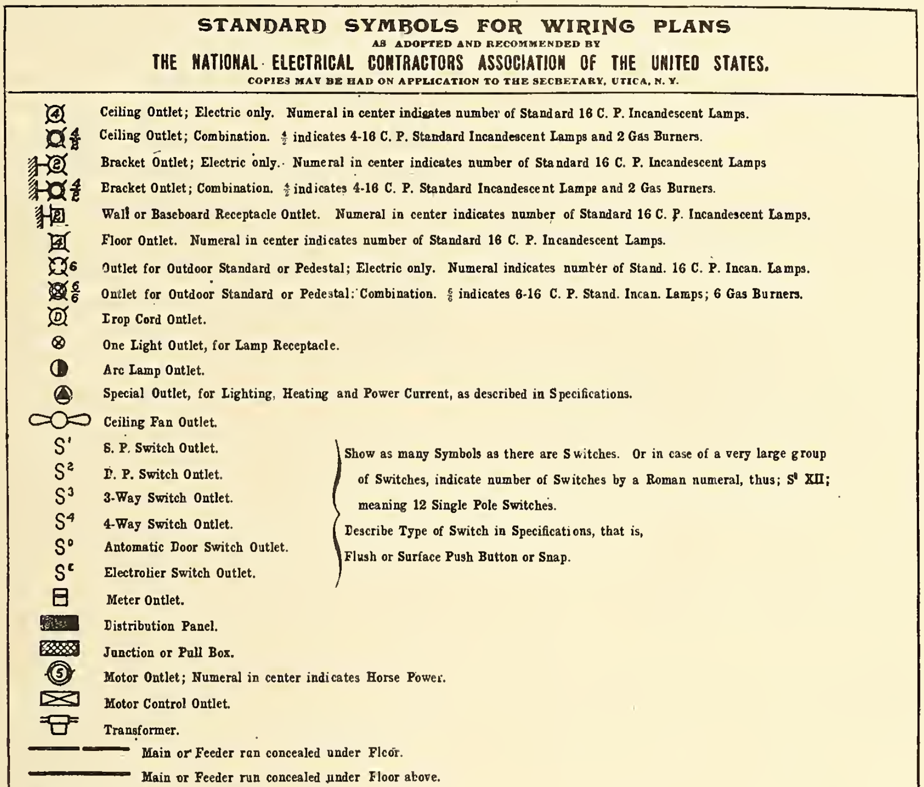
STANDARD SYMBOLS FOR WIRING PLANS.

We reproduce herewith the chart containing the symbols recently adopted by the National Electrical Contractors' Association of the United States for use in wiring plans and specifications. Such symbols should be of much value to electrical contractors, and steps should be taken to adopt a similar scheme in Canada.

A prominent electrical contractor to whom we submitted the symbols gives the following opinion in respect to their use in Canada:

"The symbols in my opinion (like most American schemes of this nature) are too elaborate—at least for us in Canada at present. These symbols run down to watchman's clock stations, bells, telephones, etc. Now, although such fittings mentioned are in use in Canada, yet it is seldom that they are put in in the scope of one specification If an expert electrical engineer were drawing out a specification for a factory and were to include everything electrical, there might be a possible advantage; but in most cases it is an architect who draws up the specification, and, although architects are quite willing to learn the points which will assist them in properly specifying electrical work, they have quite enough symbols and abbreviations for other trades without having to learn off a lot of unnecessary ones for the electrical trade that they would not use once in five hundred buildings. Again, very often the contractor who does electric light wiring does not instal the electric watchman's clock, telephones, etc. Moreover, in the province of Quebec we have certain British fittings, which are not covered by these American symbols, as the goods are foreign to the United States.

"I am in favor of adopting a limited number of symbols and making these common to the whole of Canada, and preferably let these be the same as have now been adopted in the United States. The list might take in light outlets of various kinds (for centres, brackets and receptacles), also switch outlets (single pole, double pole, three-way, etc), but let it stop here, or nearly so."



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

The Evans Engine. Mr. J. M. Evans and Mr. Kenneth Rose appeared before the members of the Engineers' Club of Toronto at a recent meeting, and gave an address on the Evans rotary engine, this machine being the invention of the first-named gentleman. It is generally acknowledged that the only rotary engines now on the market which can be called successful are those of the turbine type, of which the Parsons, Curtis and De Laval are the best known makes. Probably through usage, the term "rotary engine" is now understood to mean a machine which is not operated on either the impulse or the reaction principle, such as employed in turbines, but which expands the steam in very much the same manner as the ordinary reciprocating engine. It is a remarkable fact that the earliest engines on record were not of the reciprocating type. According to history, the first machine was built by Hero, approximately two thousand years ago, and belonged, in every sense of the word, to the reaction type. The second engine known to the scientific world was brought out by Branca in the seventeenth century, and this machine belonged to the impulse class. Of modern machines, the well-known Parsons is a reaction turbine, while, on the other hand, the Curtis and De Laval may be classified under the heading of impulse, though, to a certain extent, they all make a limited use of the opposite principle. Watt, to whom the invention of the steam engine is usually attributed, filed, in addition to his other claims, papers covering an engine of the rotary type. In recent work serious difficulties have been encountered in the construction of true rotary engines, for while the machines are often ideal in principle, the mechanical problems involved are such as to make them impracticable. There are to-day in the patent offices of various countries, thousands of documents pertaining to rotary engines, and we think that in all probability, should a complete examination be made of these, the same trouble would be encountered in each, namely, the impossibility of proper mechanical construction. Mr. Evans has worked a great number of years on his machine, and we feel warranted in saying that the practical operation tests to which his engines have been submitted show conclusively that the idea upon which they have been developed is a very feasible one. The engine, of course, has many peculiar features, but this is to be expected in any machine which is such a radical departure from familiar types.

Friction is one of the items in ordinary rotary engine work which constitutes a serious obstacle, but Mr. Evans stated at the Engineers' Club that in his machine the friction was reduced to a minimum, and where it could not be avoided entirely, the parts likely to be affected were so constructed as to keep automatically steam tight to the limits of wear. Upon examining the engine, we found that this appeared to be the case, and on one machine which had been in operation for something over two years the tool marks were still in evidence, even on surfaces where the greatest wear was to be expected. Another interesting point which Mr. Evans brought forward in connection with this vital subject of friction, was that a one hundred horse-power engine had been operated in the City of New York for almost two

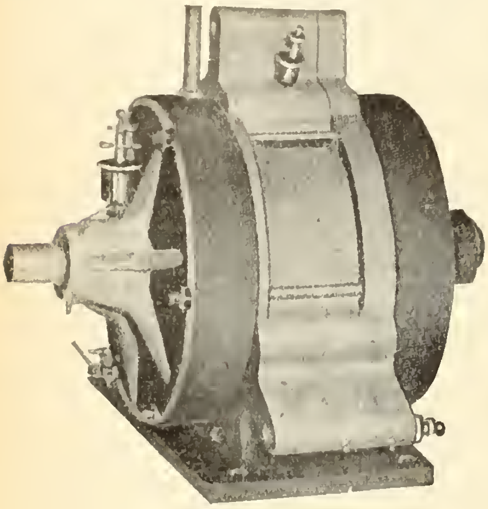
months, during which time absolutely no lubrication was used except in the bearings. A full examination was made of this machine after the above run, and no particular wear was in evidence. The engine consists of a cylinder of cast iron, with heads on either end, the shaft running parallel to the cylinder walls and perpenticular to the heads. On one head is placed the steam chest, and on the opposite one the exhaust chest, and the general arrangements are such that when steam is admitted to the exhaust end, and the steam chest opened to the atmosphere, the engine will reverse. Where constant reversing is required, such as in marine practice, special arrangements of the steam and exhaust ports are made, so that their relative positions can be changed, and hence the difficulties naturally expected with a reversing of steam and exhaust chests are avoided. The crank of the engine is usually constructed in two pieces to facilitate the removal of the parts, and on this crank is mounted the piston, which, in operation, rolls against the cylinder wall. The contact between this wall and the piston is in most rotary engines a source of considerable friction and consequently wear, but in adopting a rolling piston, Mr. Evans has certainly overcome this difficulty in a very effective manner. Another point is that while revolving, the centrifugal force of the piston tends to keep it tightly pressed against the cylinder wall, and, in addition to the contact, the moisture which will be present makes the joint effectively steam tight. The cylinder is divided into three spaces by means of slides or vanes working into fixed pockets, and the cylinder heads are grooved so that the edges of these slides are supported, irrespective of the position which they occupy at any instant. The slides themselves are wider than the piston in consequence, and extend down over its edges, carrying shoes which run in annular grooves cut into the sides of the piston grooves. While in motion, the angle between the vanes and the periphery of the piston is constantly changing, and this movement is taken up by means of an ingeniously arranged shoe.

One source of material economy which exists in this engine is the almost entire lack of what corresponds to clearance in a reciprocating machine. Of course the space occupied by the steam port has an effect of this nature, but similar space must naturally exist in a reciprocating engine. When the piston reaches a certain point, steam is admitted to one port at boiler pressure, and at this particular instant the effective area of the piston presented against this steam pressure is practically nil. Advancing a little further, a surface is presented to the steam between the slide and the point of rolling contact before mentioned. A still further advance, and this surface is increased, and so on until the point of cutoff is reached, which corresponds to about ninety degrees, or one-quarter of a revolution. The action proceeds as above outlined, and the steam expands until the piston reaches a point corresponding to two-thirds of a revolution, at which instant the area of the space is at a maximum, and the exhaust port opens. It will thus be seen that the admission and expansion covers two-thirds of a revolution. and when it is borne in mind that there are three such chambers formed in the engine, which means three steam admissions per revolution, it will be seen that, in Mr. Evans' own language, the engine works six-thirds of the time. This may appear curious, but is nevertheless a fact, for it must be remembered that while the engine is only supposed to have three spaces, there are times when it has four, two being the regular spaces, and the other two being formed in one space, which is sub-divided into two parts by the piston itself. Therefore, it is evident that one compartment will be taking steam in one of its halves, while the other half is completing its exhaust.

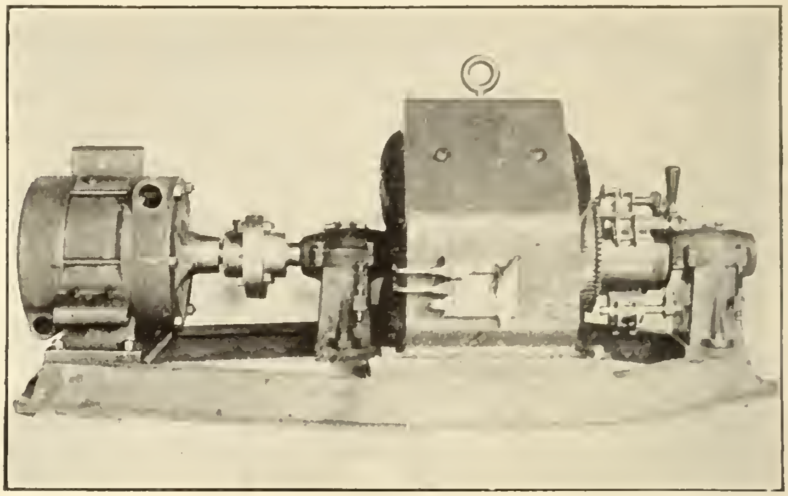
The mathematical features of this engine present some very remarkable characteristics. There are always two compartments working, and hence the force which acts upon the piston will be the resultant of the pressures and surfaces presented in these two sections. This resultant is invariably at right angles to the throw of the crank, irrespective of the position which may be occupied by the piston. Another feature which will probably come to the minds of engineers is the wear on the slides, and the consequent difficulty of keeping them tight. When we consider that there is steam pressure on both sides of the slides practically at all times, and that these pressures almost, though not quite, balance each other, it will be understood how Mr. Evans overcomes this apparent difficulty. Another feature is that when the greatest difference of pressure exists between adjacent compartments, and is therefore exerting itself upon the vane separating such compartments, the area upon which this difference of pressure acts is at a minimum, and as the area is increased, the difference in pressure becomes less, and, consequently, the wear, taken as a whole, is almost negligible. A point which came to our minds when examining the engine at the meeting in Toronto was the wear which would take place on the guiding shoes which run in the annular grooves. The motion of the piston when in action is very peculiar. When the strain on the slide is at the greatest point, there is almost no motion of these guiding shoes with reference to the surfaces against which they rub. On the other hand, where the pressure on the slide is at a minimum, the speed with which the said guides move is at a corresponding maximum. Hence the movement, which of necessity must take place at some time, occurs during the most desirable period. It may also be remarked that while the crank is making two complete revolutions, these guiding shoes make but one full turn in their grooves.

Mr. Evans has taken a great number of indicator cards from machines of various sizes, and it is decidedly worthy of note that the actual card approaches with remarkable closeness the ideal, there being some difference, however, in the expansion line, which, due to re-evaporation, is maintained at a somewhat higher point. The indicator card presents a rather curious appearance, and gives the impression that there is considerable loss due to condensation or leakage. If one will consider that in a reciprocating engine the cubic contents of the cylinder is in almost direct proportion to the position of the piston, he will appreciate the cause of the peculiar

appearance. Mr. Evans, in taking his cards, has of course found it necessary to revolve the indicator drum at a constant speed relative to the travel of the piston, this condition being precisely similar to that which takes places in indicating a reciprocating engine. The curious part of the Evans engine is that the cubic contents in any compartment does not

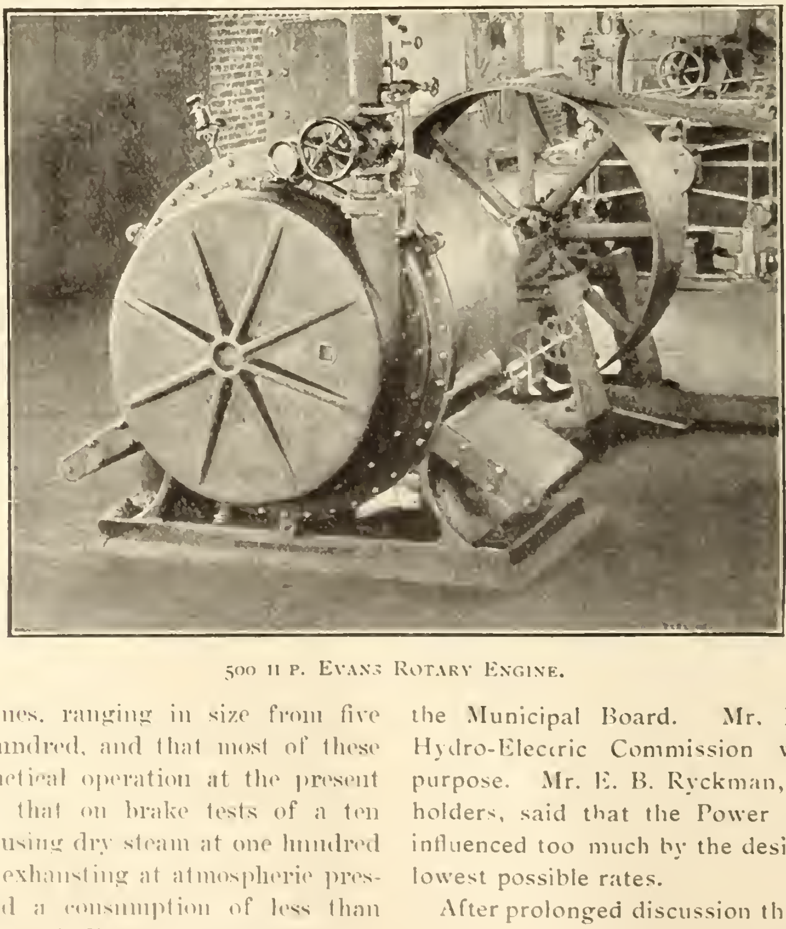


100 H.P. Evans Rotary Engine.



25 H.P. Evans Rotary Engine Directly Connected to Electric Generator

vary at a constant rate, but first has a small increment, gradually increasing to a very large one, and then slowly coming back to a small amount immediately prior to the opening of the exhaust port. We are inclined to think that should Mr. Evans take one of the cards obtained from his engine, and redraw it for a constantly increasing volume, the result would be very similar to that shown by the best grades of reciprocating engines. Mr. Evans stated in conclusion of his address that he had built a num-



500 H P. Evans Rotary Engine.

ber of different engines, ranging in size from five horse-power to five hundred, and that most of these machines were in practical operation at the present day. He also stated that on brake tests of a ten horse-power machine, using dry steam at one hundred pounds pressure, and exhausting at atmospheric pressure, he had obtained a consumption of less than thirty-three pounds per indicated horse-power per hour. If such results can be obtained under ordinary conditions of operation, the engine appears to us, even when looked upon in the most conservative light, to have before it a remarkable future.

OTTAWA'S POWER BILL.

The Private Bills Committee of the Ontario Legislature has disposed of the City of Ottawa's special legislation for this session. The principal questions decided were that the Hydro-Electric Power Commission should have the supervision of the rates to be charged by the city for power, and that the city should not have to submit for the approval of the board any power development scheme it might undertake under the authority given in the special Act. This latter decision was strongly opposed by Hon. Adam Beck.

Mr. G. F. Henderson, representing the Ottawa Electric Company, wanted the control of rates given to the Municipal Board. Mr. Beck objected. The Hydro-Electric Commission was created for that purpose. Mr. E. B. Ryckman, representing the bondholders, said that the Power Commission would be influenced too much by the desire to get power at the lowest possible rates.

After prolonged discussion the question was brought to a vote and decided in favor of the Hydro-Electric Commision by the vote of Mr. I. B. Lucas, the chairman of the committee.

The city's representatives objected to the proviso added to the clause authorizing the city to issue debentures for $500,000 to purchase or lease a water power. The condition was that the borrowing powers should not be exercised without the consent of the Hydro-Electric Power Commission. Finally the proviso was struck out of the bill.

POWER-HOUSE EXTENSION OF THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

The British Columbia Electric Railway Company is nothing if not progressive. Some years ago it was learned that Lake Coquitlam and Trout Lake (since renamed Lake Buntzen) were in close proximity to each other, the former being larger and slightly higher than the other, and separated only by a mountain, the base of which was about two and a half (2½) miles through. It was decided that Lake Buntzen alone would scarcely furnish a sufficient volume of water to generate the full electrical power required for this Company's projects, and it was decided to tap Lake Coquitlam. Such a little thing as a mountain between the lakes did not worry the progressive management of the B. C. Electric Railway Company, and work was soon commenced on what is now known as Coquitlam tunnel, the longest power tunnel in the world, being 12,774 feet in length. With the opening of this tunnel nearly two years ago Lake Coquitlam became tributary to Lake Buntzen, and from Lake Buntzen water power is supplied through the pipe-line, about 2,000 feet long, to the power-house, which is situated on the north arm of Burrard Inlet, about 16 miles from Vancouver City. Electricity at the power-house is generated from 4 units, each capable of producing 3,000 h.p., or a total of 12,000 h.p.

The Company have now undertaken extensions to this plant which will mean practically new power and transformer houses, the approximate cost being about a quarter of a million dollars. When the new work which has been begun is finally completed, this plant will have a capacity of 42,000 h.p. The additional 30,000 h.p. is to be divided into three units of 10,000 h.p. each. Work on the first unit has been commenced, and it is expected to be in operation by next November. Each unit will be supplied by water brought down a distance of 2,000 feet in two 16-inch pipes from Lake Buntzen, giving a 400-foot head. For part of this distance the pipes will be laid side by side in a tunnel 14 feet wide and 400 feet long.

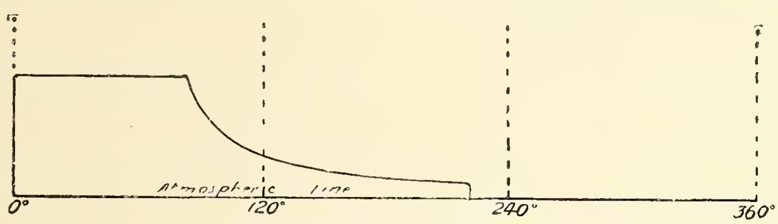
The Canadian General Electric Company, through their Vancouver office, have received the order for the supply of the generator, exciter and transformers for this first unit; the Westinghouse Company for the supply of the switchboard apparatus; the Pelton Water Wheel Company for the supply of the wheels; and the Vancouver Engineering Company for the supply of the steel pipes for the pipe-line. The total weight of the steel pipe used will aggregate about 330 tons. At the time of writing the contract for the supply of the wood-stave pipe, which will be used for about 800 feet of the pipe-line, has not been given.

Mr. V. W. Hunt, of the B. C. Electric Railway Company, will be the resident engineer.

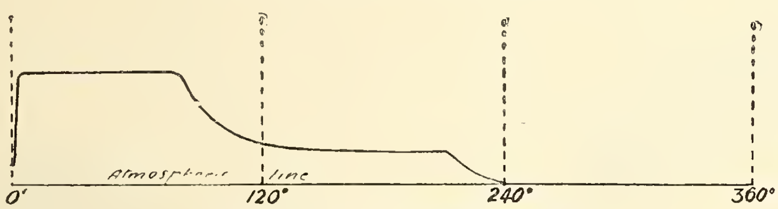
THE WASTEFULNESS OF CHIMNEY DRAFT.

In a discusion of the methods for the utilization of waste heat, the wastefulness of the usual method of producing draught by the ascent of heated air in a chimney must be considered.

Taking the boiler as the wasteful member in a steam plant, its efficiency varies from 60 per cent. in a bad boiler to 80 per cent. in a very good one, these proportions of the heat produced by the combustion of the coal being realized in steam available for the engine in each case.



Ideal Card for Evans Engine.



Actual Card from Evans Engine.

The difference may be said without greatly stretching the truth, to go up the chimney. It is not to be disputed that much of the waste heat might be caught and utilized; but there are reasons why it is not so caught. In the first place, the gases must be hot when they go into the chimney, or there will not be a draught.

As a matter of fact a draught got in this way is the most expensive possible, save one. The exception is a steam jet in the chimney. A fan can be run for about one-tenth of the power represented by the waste heat required to command a good draught. A tall chimney will cost from $5,000 to $25,000, very much more than will a fan plant. But the fan is not used and the chimney is, largely because it is essential to discharge the products of combustion high up in the air over the roofs of surrounding houses. This necessity must be taken into consideration in so far as factories are concerned, but it does not hold good of steam ships; yet we believe that in some cases a chimney stack 100 feet high would be sufficient, because with a fan combustion could be more easily controlled than is possible with a chimney, to the end of preventing the giving off of smoke.

MOTOR CONVERTERS

Many attempts have been made within recent years to devise a satisfactory substitute for the rotary converter as a means of obtaining direct current when only alternating current is available. The motor-generator furnishes an excellent device, but is both more expensive and less efficient than the rotary converter. Our issue for December 23, 1906, contained a description of a "permutator" in which the armature is stationary and the brushes revolve synchronously, the revolving magnetism being produced by stationary polyphase windings that are inductively

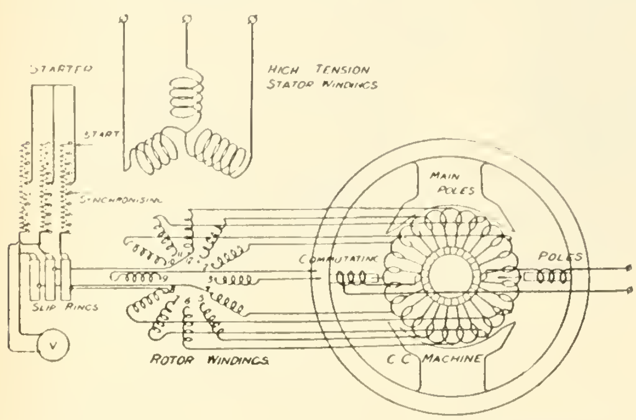


Fig. 1.—Diagram of Connections of Motor-Converter.

related to the stationary armature winding of the permutator. This Rouge-Faget machine exhibits the desirable characteristics of possessing a small mass of rotating material, and therefore can be rapidly synchronized. Moreover, the machine would neither experience nor produce any injurious effect if it were to fall out of step; its synchronizing power is enormous, so that the possibility of such occurrence is very remote.

A machine that can properly be designated as an alternating-current rectifier was described in our issue for January 12, 1907. As noted at that time, the rectifier operates to best advantage when used on electric locomotives for supplying to the motors pulsating direct current at variable voltage.

A third type of converter, and one for which many claims are made in connection with its advantageous characteristics when used to deliver constant potential direct current when the supply is high-frequency, high-voltage alternating current, was described in our issue for October 21, 1905. This machine has been introduced on a large scale for electric railway work in Great Britain, where it is stated that there are now more than four times as great capacity in use for 50-cycle current as there are rotary converters, although the latter have been available for at least four times as long. It seems desirable, therefore, to discuss at some length the properties of the machine that have led to its rapid introduction during the past two years.

As was stated in the issue referred to above, the cascade converter, or the "motor converter," as it is called in England, consists of two machine structures whose revolving parts are mounted on the same shaft. The input machine resembles in every respect an induction motor with a coil-wound (rotor) secondary; the output machine is exactly similar to a rotary converter, and it receives its current from the secondary winding of the input induction motor at a frequency much reduced from that impressed upon the primary winding.

For simplicity in explanation it may be assumed that the motor and the converter have the same number of poles. Thus the induction motor rotates at a speed corresponding to half frequency; half of the electrical power supplied to the induction motor will be converted into mechanical power and transmitted by means of the shaft to the converter, while the other half is transferred to the secondary (rotor) windings and thereby to the converter armature in the form of electrical power. Thus the induction motor operates half as motor and half as transformer, while the converter operates half as direct-current generator and half as rotary converter.

The rating of the induction motor is theoretically half as large as it would be if it were to convert the whole of the electrical power into mechanical power, because its rating depends on the speed of the rotating field and not on that of the rotor. The converter runs at a speed corresponding to half the primary frequency, which is more advantageous with regard to commutation. Consequently its design offers less difficulty than would a rotary converter for the same output and primary frequency.

The secondary winding of the induction motor is generally arranged for twelve phases, as is also the alternating-current end of the rotor to which it is directly connected. In starting up the motor converter from the high-tension side, the primary winding is connected directly to the high-potential leads.

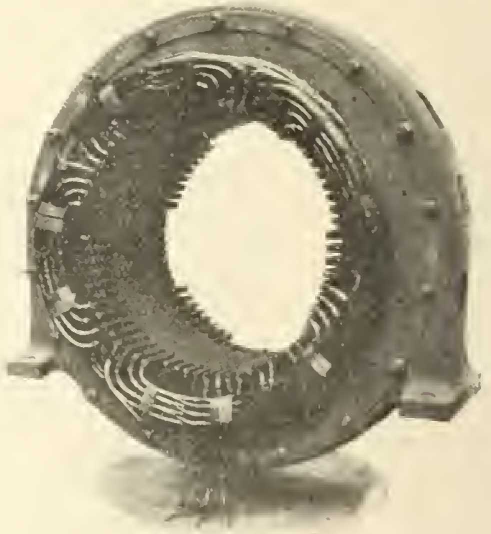


Fig. 2. Induction Motor Primary.

Three taps on the secondary winding, corresponding to three phases, are brought out to slip rings by means of which an external resistance is inserted in this circuit during the starting period. The external resistance is gradually decreased as the speed of the machine thus starts up as an ordinary polyphase induction motor. Since the secondary windings of the induction motor are connected to points on the converter armature winding, the field of the converter is built up as though it were a direct-current generator. The voltmeter shown in Fig. 1 serves to indicate when

a machine is running synchronously. It is stated that the synchronizing of a converter is so simple that no special skill whatever is required for its performance, the converter dropping into synchronism automatically a few seconds after the synchronizing notch of the rheostat has been reached. The current taken at starting varies from one-quarter to one-third of the normal current and depends upon the magnetizing current of the induction motor.

The advantages of the motor converter for single-phase service are particularly marked because the synchronizing force of a single-phase set is practically as powerful as it is in a polyphase converter, this being due to the fact that the rotor of a single-phase converter is also wound with twelve phases. Furthermore, the difference between the efficiency of a single-

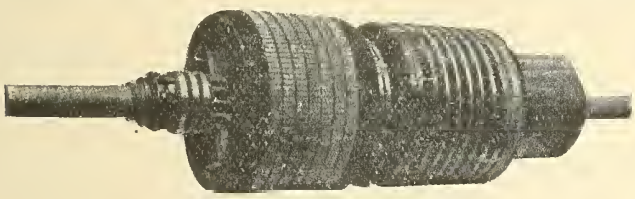


Fig. 3.—Rotor Windings.

phase and a polyphase motor converter is less than the corresponding difference in the case of rotaries of motor-generators. It is claimed that in comparison with a motor-generator the motor-converter is more economical in first cost and 2 1-2 per cent. more efficient in operation. In comparison with a rotary converter and the necessary bank of transformers, the motor-converter is about equally as expensive in first cost and has an efficiency 1 per cent. less than the rotary equipment. The motor-converter is claimed to be better than the rotary converter for frequencies above 40 cycles on account of the improved commutation at the low frequency used in the direct-current portion of the machine. For lower frequencies, such as from 20 to 30 cycles, the rotary converter is evidently preferable. For all frequencies, however, the motor-converter possesses several characteristics which render it desirable even in comparison with rotary converters. Thus the motor-converter affords much better control of the voltage of the current delivered and it requires less skilled attention.—Electrical World.

MAGNETITE LAMPS.

Magnetite lamps are now in successful operation in connection with the municipal lighting plant at Westmount, Que., this being, we believe, the first installation of the kind in Canada. The following particulars concerning their operation are furnished by Messrs. Ross & Holgate, of Montreal, consulting engineers for the Westmount plant:

The total equipment consists of 150 arc lamps, at present operating. The alternating current generated from the station is rectified by mercury rectifiers into direct current series, each circuit taking 4 amperes, each lamp requiring 310 watts. Switchboard readings at main bus bars of station show 50 kilowatts of consumption for 150 lights burning. This includes all transformers, line and lamp losses.

The electrodes used in the lamp are one copper rod and magnetite stick; the copper rod deteriorating very slightly; the magnetite stick lasting nearly 200 hours. No inner globes are used, therefore there is no cleaning or breakage.

The magnetite electrodes are replaced about one in two weeks, and the light is probably 200 per cent. better in quantity, quality and distribution combined than the 480 watt open direct current arc owing to its superior distribution.

Owing to the low wattage consumed, we figure that on a steam plant such as Westmount we can save at least $8 per lamp per year, including operating and fixed charges on the equipment.

We believe that this lamp marks a revolution in lighting, and will no doubt be followed by others equally good.

The equipment was purchased from the Canadian General Electric Company, and in all respects has so far given complete satisfaction, although we have only had as yet one month's experience.

THE STRENGTH OF INSULATOR PINS.

Much useful information regarding the comparative strength of wooden insulator pins is furnished in a late report of the Purdue University timber-testing station of the Department of Agriculture. The report covers the tests made on 53 samples of oak, black locust and rock elm. As stated, though furnishing a fairly reliable indication of the comparative strengths, the number of specimens was not sufficiently large to establish these values as absolute.

The pins were of standard size, 1 1-4 inch by 8 inches. The oak pins were from 1-8 to 1-4 in. shorter

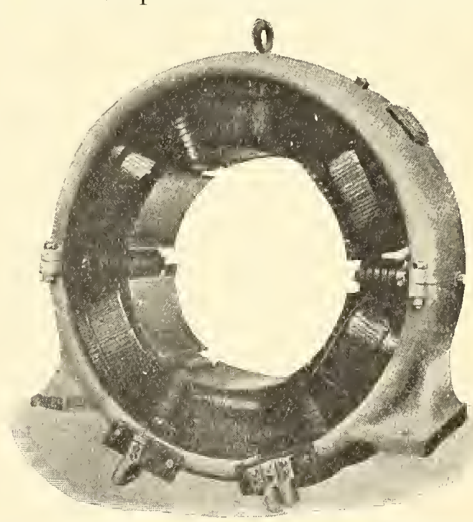


Fig. 4.—Field Frame of Motor-Converter Showing Commutating Poles.

than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about 1-2 inch shorter than in the cases of the other two species.

From the results obtained it appears that the breaking strength of the two shipments of black locust pins was practically the same, and may be taken as 4,000 pounds. Live oak pins came next in order of strength, with a breaking moment of about 3,000 pounds. Rock elm pins were the weakest, having a breaking strength of 2,500 pounds. The oak pins were the heaviest, the locust next, and the elm the lightest. The locust and elm pins failed mostly by splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by tension at the shoulder. An interesting point indicated by the results is that the breaking strength of the pins varied nearly directly as the number of year-rings per radial inch.

Stationary Engineers' Bill

A bill respecting stationary engineers received its first reading in the Ontario Legislature March 7th. It will supplant the bill introduced last session by the late Henry Carscallen providing for a Board of Examiners to issue certificates to any man desiring to operate an engine over fifty horse-power, and which law was to take effect on July 1st of this year.

Following is the text of the new Government Act:

An Act Respecting Stationery Engineers.

His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. In this Act "steam plant" shall mean and include a steam boiler, boiler and steam engine and every part thereof, and thing connected therewith or used with reference to any such boiler or engine or under the care of an engineer, but nothing in this Act contained shall apply to the operation of any steam plant having a capacity of less than fifty horsepower nor to the operation of a locomotive engine or steamboat or steamship engine.

(2) "The Board" shall mean the Board of Examiners to be appointed as hereinafter provided.

2. The Lieutenant-Governor in Council may from time to time appoint a Board of Examiners consisting of three competent and independent engineers practically conversant with the construction of boilers and the operation of steam plants, who shall hold office during pleasure and who shall, subject to the regulations referred to in the next section, prescribe the subjects in which candidates for certificates of qualifications as stationary engineers shall be examined, and who shall conduct examinations of candidates or provide for and supervise the examination of candidates and report thereon to the Minister of Agriculture.

3. The Lieutenant-Governor in Council upon the recommendation of the Minister of Agriculture may from time to time make regulations:

(a) For the examination of candidates for certificates of qualification, the granting of such certificates and the evidence to be furnished by candidates as to previous training or experience and sobriety and as to good character;

(b) For determining the time of continuance of such certificates and the renewal of the same;

(c) For fixing the fees to be paid by such candidates upon any such examination or for any license or certificate of qualification or renewal thereof;

(d) For prescribing the causes for which any license or certificate may be revoked, cancelled or suspended;

(e) For fixing the fees or other remuneration to be paid to the members and staff of the Board.

4.—(1) Upon the recommendation of the Board the Minister of Agriculture may issue licenses or certificates of qualification to stationary engineers on payment of the prescribed fees.

(2) Licenses or certificates of qualification may be cancelled at any time for good and sufficient reasons.

(3) Every stationary engineers shall, during the continuance of his license or certificate register with the Board on or before the 1st day of February of each year on a form to be furnished by the Board, and any stationary engineer who fails to comply with this regulation shall not be allowed to continue in charge of a steam plant unless by special permission of the Board.

5. No person who is not a holder of a certificate of qualification under this Act shall operate or have charge of any steam plant in the Province of Ontario after the first day of October, 1907, that in case of emergency a person not the holder of a certificate or license may be employed in operating any steam plant for a period not exceeding thirty days at any one time.

6.—(1) Every engineer who at the time of the passing of this Act—

Holds a certificate of qualification from any Association of Stationary Engineers in the Province of Ontario,

Or who shall be in charge of any steam plant in the Province of Ontario coming under the provisions of this Act,

Or who has had at least two years' experience in the operation of such a steam plant

And who applies to the Board shall, upon furnishing such evidence of good character and sobriety as the Board may require and upon payment of the prescribed fee, be entitled to receive a license for the practice of his calling as engineer for a period of three years ending 30th day of September, 1910, and not renewable after that date.

(2) Every stationary engineer holding a license under this Act and who has complied with the regulations required by this Act, who desires to continue in charge of a steam plant in the Province of Ontario after the expiration of his license on the 30th day of September, 1910, shall previous to that date pass such an examination before the Board of Examiners as is required by this Act, and shall upon payment of the prescribed fee, be entitled to receive a certificate of qualification under this Act.

7. The license or certificate held by any person under this Act shall at all times be exposed to view in the engine or boiler room in which such person is employed, and failure to keep such license or certificate exposed shall be prima facie evidence of the lack of qualification under this Act.

8. The provisions of this Act shall not apply to firemen or other workmen acting under the direction and supervision of any duly licensed or certificated engineer who is actually in charge of a steam plant, nor shall it apply to the employees of engine builders or steam plant contractors engaged in installing, setting up or testing boilers or steam plants.

9. Any person who feels himself aggrieved by the decision of the Board of Examiners may appeal therefrom to the Minister of Agriculture, upon giving such notice as the Minister may prescribe, and the decision of the Minister of Agriculture shall be final.

10. The Board of Examiners shall make a report in writing to the Minister of Agriculture on or before the 31st day of December in every year showing:

(a) The number of certificates granted by them during the preceding year, and the persons to whom the same were granted;

(b) The number of applications for certificates refused during the preceding year and the causes for refusal;

(c) The number of certificate revoked, cancelled or suspended during the preceding year, and the causes for the same;

(d) The amount of fees received by them from candidates or holders of certificates during the preceding year;

(e) Upon such other matters as may be directed by the Minister of Agriculture or the Lieutenant-Governor in Council.

11. Except as provided in section 5 of this Act, every person who operates a steam plant as the engineer in charge thereof without the license or certificate required by this Act, and every person employing him or permitting him so to do shall be liable upon summary conviction to a penalty of not less than $10 nor more than $25 besides costs.

12. Sections 20 to 32, both inclusive, of The Act respecting Stationary Engineers, as enacted by section 1 of the Act passed in the 6th year of His Majesty's reign, chaptered 26, are repealed, and section 19 of the said Act respecting Stationary Engineers is amended by striking out the words added thereto by section 3 of the said Act passed in the 6th year of His Majesty's reign.

The Canadian General Electric Company are encouraging by their literature the use of electricity for domestic purposes. The latest booklet issued by them is entitled "Ironing by Electricity."

A pretty wedding took place in Toronto on Tuesday, February 26th, when Miss Jennie Neill became the wife of Mr. B. F. Reesor, of Lindsay, manager of the Georgian Bay Power Company. Rev. S. J. Shorey, D.D., of Oshawa, was the officiating clergyman. After the ceremony Mr. and Mrs. Reesor left for western points, and on their return will reside in Lindsay. The Canadian Electrical News extends congratulations.

Y. M. C. A. ELECTRICAL CLASS.

Mr. F. Sedziak, member of the International Society of Electrical Engineers, who recently opened a course of lectures at the Y.M.C.A. at Winnipeg, was unfortunately taken ill and obliged to give up his class for this season. Owing to his indisposition and private affairs, Mr. Sedziak has decided to take a trip to Europe and will start immediately. He will, however, only remain in Europe for a little over a month and on his return intends to reopen his course at the Y.M.C.A.

Mr. Sedziak informed the writer that the most serious difficulty he experienced in giving this class was owing to many of the students being so much more advanced than others. To do away with this difficulty Mr. Sedziak will, on reopening his course, divide the class into senior and junior sections, giving separate lectures to each.

In the basement of the Y. M. C. A. is a small plant consisting of two generators and an Ideal engine, which will be used as a model.

Speaking on general subjects, Mr. Sedziak prophesied a great electrical future for Western Canada. He has noticed a great keenness among students and thinks that owing to shortage of coal and fuel electricity will in a short while become the motive power of the West.

NEW INCANDESCENT LAMPS.

This was the subject of a recent paper by Mr. J. Swinburne, past-president of the Institution of Electrical Engineers, before that organization in London on January 10th. He remarked that the metallic filament could only supplant the carbon on the ground of higher efficiency. It was very difficult, he said, to make a small lamp of 200 volts, and the question was whether the higher efficiency of the metal lamp would result in the pressure being brought down to 100 volts or less, or whether the metal lamps could be made to take 200 volts or more, either by further improvement by the use of some sort of transformer, or by using larger lamps, say of 50 candles. In his opinion the ingenuity that had made metal lamps possible was quite capable of making 200-volt 16-candle lamps within a reasonable time. It had been urged that alloys should be used for lamp filaments, but alloys generally had low fusing points, although this was not an invariable rule, and it was possible that alloys might be formed which had very high melting points. Alloying had, however, the possible disadvantage in reducing the resistance temperature coefficient. There was no reason, however, to limit the possible conductors to elements. The Nernst lamp, for instance, was made of oxides.

ELECTRICAL WORK IN VANCOUVER.

The annual report of the work of the Electrical Inspection Department of Vancouver, B. C., shows the enormous advance of the field for the electrical current in its many forms of power, light and heat. Inspections were made during 1906 on 25,347 outlets, 6137 single pole and 227 three-way switches, 1760 meter loops, 6984 lamps on signs, 42 arc lamps and 8 electric heaters.

Seventy-six electrically-lighted signs were erected during the year, and the notation of the report shows that 146 old services were condemned for various causes.

At the present time work is in hand in addition contemplating the installation of 2306 outlets on thirty-three premises.

Two thousand three hundred and six certificates were issued during the year authorizing the first connection, and 1088 for preliminary wiring.

Final fitting inspections have been made as follows: Outlets, 27,154; single pole switches, 4216; three-way, 279; meters, 2556.

Industrial development is marked by the installation of 179 motors during the year, with a total horse power of 1918.

The receipts of the department are noted as $4074, as against $2688.75 for 1905.

MOTOR DRIVEN MACHINES EXHIBITED AT THE CHICAGO ELECTRICAL TRADES EXPOSITION.

Those who went to the Electrical Trades Exposition in Chicago expecting to see the same things they saw last year were agreeably disappointed. Indeed, all except those who have been closely watching the progress of electricity were surprised at the great variety of new devices and applications to be seen. Electricity is making such wonderful strides that it takes an exhibition every year for one to keep track of it.

One of the most marked advances is in motor application. The electric motor is not only successfully replacing every other form of power drive, but is fast abolishing manual drive for even the smallest machines. There is scarcely any type of machine that cannot be driven more economically, conveniently and efficiently by the modern small power motor—now made in units as small as 1-25 horse power—than by hand.

In the Westinghouse exhibit alone there were to be seen twenty odd machines of widely varying types, driven by motors exactly suited to their requirements. There was scarcely a visitor to the show who did not find some type of machine in which he was directly interested, and many went away with new ideas of economy and convenience.

There were machines not only for the manufacturer, but for the butcher, the baker and the candle-stick maker as well, and many too for domestic purposes, that interested all comers. It is only lately that electricity has meant anything more than light, in the home. That this is only one of its many uses was demonstrated by the motor driven household utensils in operation in the exhibit, including a washing machine, an ironing machine, a sewing machine and a sanitary cleaning and scrubbing outfit. The latter device attracted universal attention through its ability to remove quantities of dust and dirt from apparently dustless clothes, rugs, upholstery, etc. The use of a plant of this nature for private residences depends upon the motor drive, as any other form of power would be too expensive and require too much space and attention.

It goes without saying that a form of power which is economical enough for domestic purposes, is well adapted to the requirements of those who cater to the domestic needs on a large scale, and so hotel keepers, grocers, laundrymen, bakers and confectioners found many of their machines of daily use among the motor driven, such as coffee grinders, dough mixers, ironing mangles, refrigerating machines, clothes washers, dish washers and ice cream freezers. That electric motors furnish ideal power for all such machines was apparent to all who saw them in operation.

Among the machines of interest to manufacturers were a lathe, a saw sharpener, a ventilating fan, a printing press, a drill and a blacksmith blower. Merchants found an interesting device in the motor driven automatic pin ticketing machine, which is fast replacing the old method of price marking goods by hand.

Those who visited this interesting and educative exhibit went away wondering if there were any machines left to the driving of which the electric motor had not been adapted. If there are any such, next year's visitors will undoubtedly find them on the list.

METER TESTING

By Oliver J. Bushnell.

During the last decade wonderful improvements have been made in all kinds of electrical machinery and apparatus. Only a little more than 10 years ago there was exhibited at the Chicago World's Fair a "Jumbo" generating set consisting of two 400 kilowatt dynamos directly connected to a 1,200 horsepower vertical engine, and later, when this was installed in the Harrison street station of the Chicago Edison Company, the advisability of such large units was seriously questioned. To-day dynamos of 12,000 kilowatt capacity are in daily operation by the same company. A like progress, though perhaps not quite so apparent, has developed the electricity meters of the present. The old chemical meters and fan-braked induction meters have been discarded for instruments which, with proper care, will give almost absolutely accurate results throughout their whole range. Meters which can run with such accuracy are naturally more delicate than their predecessors. Friction has been reduced to a minimum in their design and all the parts are carefully proportioned and adjusted. If such meters as these are to retain their accuracy, the bearings must be kept polished, the starting torque adjusted to local conditions and all parts clean and free from dust.

As a result of these conditions, meter testing is a well-recognized branch of the work of up-to-date companies. There is hardly a central station manager who now questions the advisability of comparing customers' meters periodically with a reliable standard, any more than he would neglect to compare his watch occasionally with a standard chronometer. The principle of the matter is well accepted, but when it comes to expending the money necessary for the work some are apt to be "penny wise and pound foolish."

Periodic Tests.

Probably the most important point to be considered in connection with our subject is the frequency with which meters should be tested. Most central station managers believe that, as a matter of general policy, meters should not run much longer than a year without testing, both as a protection to the company against loss, and as an assurance to their customers of the correctness of their bills. These men would doubtless also assent to the proposition that it would pay to give special attention to meters involving a large amount of income. We cannot, however, arrive at the proper frequency of tests with any correctness without a study of the conditions which affect meter accuracy.

We find that in all meters the revolving part is mounted on a jeweled bearing, which in time becomes rough; again, that the permanent drag magnets are liable to change from aging, rough handling or short circuits; again, that in commutator-type meters, the commutator and brushes will wear and become rough from sparking; lastly, that all meters are influenced more or less by vibration, dampness, dust and other conditions of installation. Jewel wear, the first of these causes which affect meter accuracy, is influenced chiefly by the weight of the moving element, the number of these is constant for a given type of meter; the second is easily ascertained from the meter readings, and the influence of the last can be learned from successive tests.

Just how much wear a jewel will stand is somewhat uncertain. Sapphire, which is almost universally used, is of uneven structure, and variations in the quality of jewels cannot be eliminated by the most careful inspection in their manufacture. In a report on "Jewels and Pivots" in commutator meters, made a few years ago by the meter committee of the Association of Edison Illuminating Companies, it was suggested as a result of about 200 time tests that 800,000 revolutions be taken as the limit of wear of sapphire jewels in meters not subject to vibration, with half that number as the limit where vibration was constant. Since that time commutator-type meters have been very much improved, and in the latest type the weight of the moving element is only one-third as much as formerly. It does not appear that the decrease in jewel wear is directly proportional to the decrease in weight of the moving element but it is probably nearly so. It would doubtless be more accurate to adopt a different limit of revolutions for each type of meter, in which the weight of the moving element is different, but for convenience 1,000,000 revolutions has been quite generally adopted as the limit of wear for sapphire jewels in all commutator meters.

The writer has not any direct data on the wear of sapphire jewels in induction meters, and here again the weight of the moving element varies in different types of meters; but from a comparison of these weights with those of the moving elements in commutator-type meters and from the lesser number of jewels found defective in annual tests of induction meters, it is evident that a jewel will stand at least two or three times the number of revolutions in an induction meter that it will in a commutator type. The writer believes the limit of wear of 2,000,000 revolutions, adopted by a large eastern company, is certainly safe.

About 2 1-2 years ago there was discovered a process of cupping diamond jewels for meters, and since then they have come into considerable use. One company has made tests of these jewels up to 9,500,000 revolutions without the stone showing any wear, but in some of the tests the shaft points became so flat as to introduce considerable friction. What the average life of the jewel is we cannot state, but believe that it can safely be taken at five times that of sapphire jewels, and that it is probably more than this. Although the adoption of diamond jewels largely removes jewel troubles, the elements of magnet change, commutator friction and deterioration, due to local condition, still remain to be considered. These are so uncertain that they cannot be classified directly, and the old limits of registration between tests originally adopted for sapphire jewels have been adhered to quite generally among those companies which are using diamond jewels, on account of possible deterioration from these other causes.

There is an important factor also in meter construction to be considered in this connection which

makes the size of the meter an element to be considered in determining the frequency of tests. Meters of a given make have approximately the same full load torque in all sizes. It follows that a meter of large capacity will at times necessarily operate with much less torque than a meter of small capacity, with a resultant increased liability to error. To illustrate, suppose a five ampere 100 volt meter and a 50 ampere 100 volt meter are both recording a load of one 50 watt lamp. The first is running on a 10 per cent. load, with 10 per cent. of its full load torque, and the other on a one per cent. load, with only one per cent. of its full load torque.

As the full load torque of both meters is the same, it follows that the small meter has 10 times as much torque on one lamp as the large one. Suppose also that it takes one-half of one per cent. of the full load torque to overcome the friction of the bearings, the small capacity meter would run five per cent. slow, while the large capacity meter would run 50 per cent. slow on the 50 watt load. It is at once evident that meters of large capacity should be kept in better condition and more frequently tested than those of small capacity.

In accordance with the foregoing considerations meters should be classified for testing somewhat as follows:

First—A limit should be set within which all meters should be tested.

Second—A classification should be made according to sizes, so that the large meters will be tested oftener than the small ones.

Third—A classification should be made according to the work done by the meters, so that they will not be allowed to exceed a fixed number of revolutions between tests.

Fourth—Changes in classification should be made to allow for local conditions, as made evident by the results of successive tests.

In order to find out the methods now used in meter testing, the writer sent out a number of questions on the subject to twelve of the largest companies in the country. The first two were as follows:

1. How often are your electricity meters tested?

2. On what basis is the frequency of tests determined?

Following are four of the answers received:

First Answer.—1. By inspection once a year. 2. The basis of the frequency of tests is assumption that meters should be inspected at least once a year.

Second Answer.—1. From one month on largest meters to fifteen months on induction meters in residential districts, all meters coming, as a rule, within either one, three, six, nine or twelve-month classes. 2. On the basis of the work which the meter is doing, the intention being to test at every million revolutions of the disk in direct current meters and every 2,000,000 revolutions in induction meters.

Third Answer.—1. As a general rule, once in twelve months; some are tested monthly, quarterly and semi-annually. 2. The period is decided by the amount of the monthly registration, varying, of course, with the various sizes of meters. All meters tested more than once a year are equipped with diamond jewels. Our data show that a meter equipped with a diamond jewel need not be tested until it has made a million or more revolutions.

Fourth Answer.—Our meters are tested each time they are returned to meter shop, regardless of time they have been installed. Others that have been installed three years are changed, tested and cleaned up. We do not test meters on customer's premises unless requested to do so.

Commenting on these replies, the writer believes that the first system must result in the meters measuring the largest consumption showing the poorest accuracy.

The second tends to keep all meters on a level of accuracy at the same per cent. loads, but will result in a disproportionate loss from the large capacity meters on light loads.

The third system, which takes the size of the meter also into account, will not only keep up the accuracy of the meters under heavy service, but will also maintain the accuracy of the large capacity meters operating considerably under light load conditions.

The fourth system, the writer believes, is faulty both in allowing too long a time between tests, even for induction meters, and also in the method of testing, which will be taken up later.

The classification adopted by the writer about two years ago for commutator meters was as follows:

Annual tests for meters of five to ten amperes capacity.

Semi-annual tests for meters of 15 to 50 amperes capacity.

Quarterly tests for meters of 75 amperes capacity and above.

Meters making over 1,000,000 revolutions of the disk between tests on above classification to be changed to more frequent class, so as not to exceed that number between tests, up to the quarterly class.

It has not been thought necessary to test any meter oftener than once in three months. Where a meter has not retained its calibration for this length of time, an investigation has been made. Such rapid loss of accuracy is usually found to be due to commutator trouble, caused either by excessive vibration or heavy momentary overloads. In the first case, the meter has been moved or mounted on a spring board, and in the latter a larger meter has been installed, with a better resultant accuracy than if the old meter had been left as it was and tested monthly. All meters tested quarterly have been equipped with cupped diamond jewels, and the semi-annual class are being so equipped as rapidly as they can be obtained.

A study of the data compiled from the tests made according to the foregoing schedule reveals some interesting facts. In the first place, the accuracy of the meters improves in an increasing ratio the more frequent the testing. The quarterly tests at one-half load show 15 per cent. more of the meters to be accurate than the annual tests, while the improvement shown by the light load tests, which are made at one-tenth load, is still more marked. The same increasing ratio of improvement the more frequent the testing is seen in the average accuracy obtained from these tests, which was as follows:

	One-half Load in Per cent.	One-tenth Load in Per cent.
Annual tests	97.3	89.6
Semi-annual tests	97.8	90.8
Quarterly tests	99.1	96.5

An important showing from the data of the meters out of calibration is the ratio of the meters slow to those fast, which, at one-half load, was more than two to one, while at one-tenth load it was five to one. On still lighter loads, the ratio would doubtless be further largely increased. It was also shown by the data that the type "C" commutator meters maintained their accuracy much better than the older types with heavier moving elements, especially on light loads, where the greatest improvement was needed. A better accuracy was shown by the annual tests of type "C" meters than by the semi-annual tests of meters of the older types.

The writer has not given the above schedule, however, as a model, but rather as an illustration. In the light of the results obtained, he expects to make some changes for the coming year. It would seem as though some differences should be made in the classification of commutator meters as regards the type, though the use of diamond jewels in all the older types may largely obviate the necessity. In particular, however, it would doubtless be advantageous to test more of the meters quarterly, placing at least more of the meters of the older types in this class.

Induction meters have so far been classified by the writer on an annual basis for testing. Owing to the light weight of the moving element and the absence of commutator friction, these meters retain their accuracy much better than the commutator type. Data, compiled from about 14,000 annual tests, showed an accuracy almost identical with that of commutator meters, under quarterly testing. As it is probable, however, that the meters measuring the largest consumption are below the general average, it is expected the coming year to test the larger meters and those showing over 3,000,000 revolutions between tests on a semi-annual basis.

Installation Tests.

Having decided on some schedule for periodic testing, an important point to be next considered is the advisability of making installation tests. It is well known that meters transported some distance are liable to slight changes in calibration; also that direct current meters, unless connected according to polarity markings, or, even if so connected where influenced by magnetic fields from other conductors, will show some error on light loads. The questions sent out by the writer brought back the information that two of the largest companies in the country make a test on every meter installed before the first bill is rendered, notwithstanding the fact that the meters have previously been corrected in the testing room. In the Chicago Edison Company it has been the practice to have all meters after installation inspected, and cleaned and adjusted, if necessary, so as to run freely on a light load. In order to get some information as to the condition of meters after their installation, and as to whether an inspection or test is advisable, the writer made 100 tests of commutator meters and 100 tests of induction meters immediately after they were installed, these meters having all been adjusted in the shop before being sent out. The accuracy after installation, as shown by these tests, was rather disappointing, especially so in commutator meters on light loads. Tests were then made on an equal number of meters after the usual starting inspection. These tests showed a decidedly improved condition of these meters over the others, especially on light loads, and a better accuracy than that shown by any of our periodic tests. Still, there were some meters which showed a change of from five to ten per cent. in their whole calibration. It is particularly desirable that the bills of a new customer should be absolutely correct. If a meter is slow for two or three months and then is corrected, it leads to the suspicion, when the bill goes up, that the company is increasing the bills arbitrarily after it feels sure that the customer will be permanent. The conclusion seems warrantable that both alternating current and direct current meters involving considerable consumption ought to be tested within one month after installation. The direct current meters will be left in a more permanent condition if allowed to run for two weeks before testing, so that the commutator will have become oxidized. For the large class of small meters for offices, apartments and houses a careful inspection appears to be a sufficient safeguard. Perhaps a good division would be that meters which it is advisable to test oftener than once a year should have an installation test and others an inspection only.

Methods of Testing.

The methods of testing should have some attention, which, of necessity, is very much abbreviated. The first important point is to have accurate standards. A laboratory standard voltmeter, a standard shunt and a precision indicating wattmeter make excellent working standards. These should be returned to the factory occasionally for calibration, unless the company has a laboratory, where they can be checked. In the absence of these, a set of the working instruments should be kept for checking other instruments only, and returned to the factory for recalibration every six months.

Meters can be tested on the customer's premises or brought in and tested in the shop. Some have contended that the latter is the more accurate way, as conditions are more favorable for correct measurements. The necessity for installation tests, which is shown in a previous part of this paper, proves conclusively, however, that meters should be tested under local conditions in which they are to operate, and after all danger of change from transportation is over. Even if a meter is taken out and installed with the utmost care, so as not to disturb the original calibration in the slightest, frequently some change in the light load adjustment is necessary to adapt it to local conditions of vibration or adjacent magnetic fields.

Four methods of testing are in general use:

1. With ammeters, voltmeter and stop-watch.
2. With calibrated resistance, voltmeter and stop-watch.
3. With indicating wattmeter and stop-watch.
4. With check-recording wattmeter.

The first method is used only on direct current work, and the second should be only so used unless the resistance is absolutely non-inductive. Self-contained shunt Weston ammeters, on account of temperature error, should not be used except in small sizes, and even then the current should be kept on the

instrument only during the time necessary to make each test. Resistance shunts with negligible temperature co-efficient and milli-voltmeters should always be used for measuring large currents. The indicating wattmeter should be used only for alternating current work, as it is not reliable on direct current, owing to the influence of external magnetic fields. The check-recording wattmeter has the advantage of not requiring a stop-watch, yet if a portable load is used the inspector can tell the per cent. load on the meter with sufficient accuracy. An ordinary meter can be placed in a carrying box and used for checking, but it is better to use one of the special test meters, of which there are two or three kinds on the market. These meters are built with several field kindings, so that the full torque of the meter is available at different loads. The meter under test can accordingly be tested with equal accuracy at heavy and light loads by connecting to the field coils of the corresponding capacity in the test meter. This method is particularly advantageous where a meter must be tested on a fluctuating load.

Each method of testing has its advantages, and each will be found best, doubtless, for some kinds of work. The writer has had all in use, and finds no particular advantage of one over the others in the amount of work which can be accomplished. He inclines to the belief, however, that the test meter with several field windings will soon have more general adoption and prove slightly more economical than other methods.

The number of meters which can be tested by an inspector in one day has been variously reported by the different companies from which data were secured at from six to ten. The writer believes an average of about seven should be obtained in testing commutator meters and eight or more in testing induction meters.

The use of diamond cupped jewels is recommended in all of the older type commutator meters where the jewel is subject to heavy wear. Sapphire jewels may be once repolished, but the stones should be removed from the screws and polished and inspected, the same as new stones, and set in new screws. If polished in the old setting some of the powder is apt to be left in the screw and cause trouble. Pivots also may be used a second time if they are carefully repointed and polished. A new pivot or shaft should always be inserted when a jewel is changed.

It is advisable to test meters at two points. The light load calibration is usually made at one-tenth load and heavy load at from one-half to full load. It makes no difference whether one-half or full load is used, as far as the final calibration of the meter is concerned, but the reports of the meters as found would doubtless show better on a full load test. One-half load is used by the writer as being nearer the running condition of the meter. Whatever tests are made an accurate record should be kept and the results carefully tabulated. Only by an accurate knowledge of the condition of his meters and a study of the results of his testing can a central station manager satisfy himself as to whether or not he is warranted in the expense he is incurring.

It is estimated that 105,000 people actually attended the recent Electrical Show at Chicago, the largest day's attendance being on Edison Day, when 12,000 visitors were present.

THE ZIRCON-WOLFRAM METALLIC FILAMENT LAMP.

After the reading of a paper on "New Incandescent Lamps," by James Swinburne, at a meeting of the Institution of Electrical Engineers of Great Britain, held January 10, much interest, says the Electrician, London, was taken in the exhibition of a metallic filament lamp, known as the Zircon-Wolfram lamp, suitable for pressures of 200 to 220 volts, as hitherto it has been impossible to get a metallic filament lamp suitable for high pressures.

It appears that this lamp is the invention of Dr. Zernig, of Berlin, who has been working at the subject for some years. The filament was originally made of zirconia mixed with carbon. This gave a high efficiency filament, but only suitable for low pressures. Subsequently tungsten was introduced. As to the exact process used, it is difficult to obtain any exact information, but it appears that it depends upon utilizing hydrogenous combinations of metals. Nitrogenous combinations have also been used, but they are less suitable, as higher temperatures have to be used in the chemical operations. Hydrogenous combinations seem to have been first used by Winckler, but only to a slight extent. The material that is obtained is in such a form that the filaments can be made by a process of squirting, which, of course, is a very great advantage, as it is probably owing to this that low candle-power lamps can be made. Lamps are at present made for sixteen candles on 100 volts, or thirty-two candles on 200 volts.

The introduction of tungsten into this particular lamp has enabled an extraordinarily rapid advance to be made in the pressure at which it will run. Thus, although the pressure was only thirty-seven volts, rather more than a year ago, this pressure has now been raised to 220 volts. The advantage in being able to adhere to the simple squirting process is seen not only in low candle-power but also in the cost of manufacture, which is said not to exceed that of the manufacture of carbon filament lamps by more than one pense (two cents) per lamp. This, of course, does not mean that these lamps will be put upon the market at practically the same price as the carbon lamp, but it is proposed to sell them at two shillings six pence to three shillings (sixty to seventy-five cents) each, which can not be regarded as excessive for a high-efficiency lamp.

As to the results obtained, the lamp has been found to run equally well on alternating as on direct current. It is not fragile, and the efficiency is about 1.2 watts per candle. Early tests on thirty-seven-volt lamps at the National Physical Laboratory gave excellent results. According to a test carried out by the Westminster Electrical Testing Laboratories in the spring of last year, the efficiency of a 115-volt thirty-five candle-power lamp varied from 1.75 at the start to 2.24 at the end of 1,000 hours; but the report of a later test, carried out on the continent at the end of last year, on some 200-volt sixty-five candle-power lamps, showed a considerable improvement on this, the efficiency being about 1.38 watts per candle at the start, and about 1.28 after 500 hours.

A petition is being circulated in Ashcroft and the Cariboo, in British Columbia, asking the Dominion Government to establish a telephone service between Ashcroft and Bakerville.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

QUESTION No. 1.—Kindly tell me in your next issue if possible how to make and use the calorimeter known as the "barrel type." Also explain fully the use of this class of apparatus.

ANSWER.—The calorimeter, when used in connection with steam, is a device for ascertaining the quality of the steam, that is to say, whether it contains moisture, and if so, what quantity, and if not, what degree of super-heat, if any, is present. You are doubtless aware of the fact that at atmospheric pressure (taken at 14.7 lbs. per square inch) water boils at a temperature of 212 degrees Fahrenheit. If the water be confined in a close space, such as a boiler, and the pressure in this space be raised, the boiling point of the water increases. For instance, if the guage pressure be 100 lbs. (114.7 lbs. absolute) the boiling point is approximately 337 degrees Fahrenheit, while with a gauge pressure of 150 lbs. (164.7 lbs. absolute) the boiling point is approximately 365 degrees Fahrenheit. If the steam given off by any boiler has exactly the same temperature as it should have for the pressure in the boiler, it is then said to be in a condition of saturation. If the temperature of the steam, however, is lower than that indicated by the pressure, the steam is said to contain moisture, while, on the other hand, should the temperature be in excess, the steam is said to contain superheat, the number of degrees being the difference between the actual and saturated temperatures. In order to obtain superheat, a boiler must be specially constructed for that purpose, or there must be auxiliary apparatus for raising the temperature of the steam after it leaves the boiler. Steam in contact with the water in the boiler cannot contain superheat. The calorimeter known as the "barrel type," which you mention, is a somewhat obsolete method of ascertaining the quality of the steam, and it is liable to considerable error. Connection is made with the steam pipe in the manner common for calorimeter tests namely, a ½" pipe, perforated, is inserted into the steam pipe extending almost to the opposite wall. This small pipe has of course a valve close to the main steam pipe, and on the other side of the valve a proper length of rubber hose is attached. The pipe, valve and hose must be carefully insulated. A barrel is then obtained and placed on a platform scale, and into the barrel is put a certain quantity of water, the amount being governed entirely by convenience. The small valve is opened, and after sufficient steam has blown through the hose to thoroughly warm it, the end of the hose is plunged into the water in the barrel, and the steam which issues is consequently condensed. The hose is kept in the barrel until the water reaches a temperature somewhere in the neighborhood of 120 or 130 degrees Fahrenheit, care being taken that throughout the test the water in the barrel is constantly agitated by mechanical means. When the proper temperature is reached, the steam is cut off and the hose removed from the barrel. The following formula then gives the quality of the steam:

$$Q = \frac{1}{H-T}\left(\frac{W}{w}(f-h)-(T-f)\right)$$

Where

Q = quality of steam, saturated steam being unity.

H = total heat of one pound of steam at observed pressure.

T = total heat of one pound of water at the temperature of steam of the observed pressure.

h = total heat of one poundof the original condensing water.

f = total heat of one pound of final condensing water.

W = weight of original condensing water.

w = weight of steam condensed.

The results given by any barrel calorimeter, where the test is carefully conducted, will probably be within two per cent., that is to say, a sample of steam which by this means shows two per cent. moisture, may in reality contain anywhere from zero to four per cent. Generally speaking, we would be inclined to say that the throttling calorimeters, designed by Professor Carpenter and others, will give more accurate results. These are cheap to make and simple to operate, though they cannot be used where there is a large percentage of moisture in the steam. In the throttling calorimeter a small brass nozzle is attached at the valve previously mentioned. This nozzle should have a discharge opening not exceeding 1/16" in diameter. Screwed on to the end of this discharge nozzle is an ordinary tee placed with the run vertical. In the top of the tee is screwed a bushing, and into the bushing a small piece of brass pipe closed at the lower end. From the lower end of the tee, ordinary iron fittings are run to the atmosphere. The whole must be carefully insulated as in the case of the hose for the barrel calorimeter, and the brass pipe inside the tee when filled with ordinary cylinder oil constitutes a thermometer well. The thermometer is put in place and the valve opened, and steam is allowed to blow through the calorimeter until all parts reach a constant temperature. Care must be taken in all these tests to use a correct gauge for ascertaining the pressure in the steam pipe, and in the throttling calorimeter the connections must be such as to make the pressure surrounding the thermometer well the same as the atmosphere. The formula for getting the moisture or superheat in the steam is somewhat lengthy, and the matter is usually reduced to simple tables, from which the moisture can be calculated directly. They show the moisture for various gauge pressures, which is indicated by the difference of temperature given by the thermometer and the amount which the steam should show at the pressure given by the gauge.

QUESTION No. 2.—Mr. Sammett's paper on polyphase systems very much appreciated, but would like to ask a few questions to carry it a little further into the secondary distribution of polyphase systems.

(a) In connecting our secondaries in delta, how can we get 220 volts for motors and 110 for light without using six secondary wires and very complicated connections? (b) Or would we require to run threr neutral wires in order to use the three phases on the

same street? (c) Can we use two transformers on oue three phase line and get three phase current for three phase motors at 220 volts and 110 for lighting from the same secondary wires by carrying a neutral? (d) Do two transformers connected with the V connection unbalance a three phase line, or can two transformers be used to transform three phase to three phase?

Answer—We would first point out to our correspondent that he has evidently misunderstood the contention of Mr. Sammett, where, on page 4 of his paper, he advocates the use of three wire three phase distribution. This does not refer to the 110/220 or possibly 500 volt current which is fed directly to motors and lights, but covers the general distribution of power and light at 2200 volts. (a) It is almost universal practice to use 400 or 500 volts for motor work, distributed to the machines as three phase current over three wires, and for lighting to use single transformers giving 110 volts secondary when a two wire arrangement is used, and 110/220 volts when a three wire secondary is used. So far as the service transformers are concerned, it is not standard practice to combine apparatus for lighting and power, and it would certainly complicate things very much to run six secondary wires. If you wish to combine your service transformers so as to supply both light and power, we would suggest that you make one of the transformers larger than the other two, and run a neutral wire from the central point of the secondary, and do your lighting entirely on this circuit. (b) If you wish to use the three phases for lighting on the same street, or within a very short distance of each other, it would of course be necessary to use three neutral wires, but, as pointed out above, there is no occasion for any such construction. (c and d) Two transformers connected V can be used to transform three phase to three phase without producing any unbalancing whatsoever if the secondaries are run two wire. You would be able to get three phase current for motors at 220 volts from such an arrangement, and if you ran neutral wires from the secondary of each transformer you would get two 110/220 volt systems, but across the third phase you would still have 220 volts. In order to obtain the third neutral wire, a balancing coil or another transformer would have to be inserted. We are inclined to think, as mentioned above, that your misconception of this matter is due entirely to the fact that Mr. Sammett, in the paper published, does not consider the low voltage side of the question at all. The 2200 volts referred to above may of course be either higher or lower than this amount, and may be supplied direct from the generators, or may be the result of step down transformers in a substation.

NOVA SCOTIA STATIONARY ENGINEERS.

The Commission appointed to enquire into legislation as affecting stationary engineers, held its second meeting in Halifax recently. There were delegates present from many parts of the province to give evidence. The following are some of the changes which the Commission will likely suggest. The sections are from the Regulation of Mines Act :

"76. No person shall be eligible for examination for third class certificate unless ;

"(a) He is at least eighteen years of age ; and

"(b) He must be the holder of a fireman's license, and shall have served 12 months at mechanical work in a machine shop, or has served for 12 months as engineer, pumpman, fireman, oiler or locomotive engineer.

"77. No person shall be eligible for examination for a second-class certificate of competency, unless ;

"(a) He be at least 21 years of age ;

"(b) And is the holder of a third-class certificate of competency, and has been employed as a third-class engineer for not less than two years.

"78. No person shall eligible for examination for a first-class certificate of competency, unless:

"(a) He is at least 24 years of age ;

"(b) Is a holder of a second-class certificate of competency or service, has served one year at repair work on mining machinery, and has for 12 months been in charge of an engine of not less than 250 H. P.

IV. EMPLOYMENT OF ENGINEERS.

"79. Every engineer in charge of a steam plant of not less than twenty-five and not more than five hundred h. p., shall be the holder of at least a third class certificate of competency, or a certificate of service equivalent thereto."

In (b) section 76 the word "and" after license, should to make sense read "or,"for certainly the statute should not give preference to a fireman without a certificate over one having a license. In (b), sec. 78, the word "machines" should be machinery. The chairman of the Commission objects strongly to a "twenty-five" h. p. plant calling for a man in charge. He maintains that at a small colliery a man in charge of the plant—as chief engineer—is wholly unnecessary. The manager who has a certificate is quite competent to discharge the duties. A manager's technical knowledge is put to a severe test, in the "Mechanics" questions, required to be answered before a certificate is granted.

NEVA FALLS TO BE HARNESSED.

The new town of Neva, situated on the new G.T.P. line, 50 miles from Winnipeg, is shortly to have electric power. Mr. A. Anderson, President of the Neva Development Company, speaking to a representative of this journal, said :—

"For the development of Neva the Company propose in the early spring to utilize the power resources of one of two water falls which are situated on their property. One of these, the "Neva" Falls, within the radius of the town-site, has a capacity of from 250 to 400 horse power when the water supply is normal, while the other and larger falls are situated 2½ miles from the town-site in a sraight line. By damming the river these would give a head of 14 feet 4 inches and provide easily a capacity of 400 to 600 horse-power. As soon as weather conditions permit uninterupted working, the Company will commence damming operations and erecting power station and plant in connection with the former or town-site falls, which they hope to complete with all transmission facilities at a cost of $8,000 to $10,000.

"When this has been accomplished the company will be able to supply the town with light and the railway with water, there being no satisfactory water supply between Rainey and Winnipeg other than what may be derived from the Whitemouth River."

The company's head office is at Winnipeg.

Electric Railway Department

MODERN REPAIR SHOP METHODS.

At a recent meeting of the Canadian Street Railway Association, W. R. McRae, master mechanic of the Toronto Railway Company, read an interesting paper pointing out some of the changes that have taken place in modern electric railway repair shop methods and describing some of the methods in vogue in the Toronto Railway shops. Mr. McRae said in part:

There is no department of electric transportation which has so completely changed its methods as the repair shop of the modern electric railway. A glance at the procedure and equipment of a modern electric railway shop by one who has worked in the old days of risk and chance, but who is not now engaged in electric railway work, will cause the "has been" to figuratively scratch his head and recall memories of the old days when he was "up against it." He would very likely recall how he used to remove armatures from the motors by using a tripod and rope block, or took them out from below with the aid of a screw jack and 2-inch plank. He would also probably tell how he was accustomed to file his commutators perfectly round by hand. He could if he wished describe many other things which he used to do, which to the shop man of to-day would appear ridiculous. The writer knows from his own experience that these methods were, in the early days of electric transportation, a necessity. Then the "handy man" was practically indispensable, as his duties would not only require him to do electrical repairs to cars, power station, line and track, and not infrequently run a car as well, but he was quite often obliged to attend to the boilers and look after the engine in the event of the illness of the regular engineer.

Circumstances are now altered, and the fact that electric transportation is no longer an experiment, but an important factor in the business of the world, has enabled us to secure more modern methods in repair work. As a matter of fact, the necessity of having modern and reliable equipment in our rolling stock is fully recognized as being of the utmost importance by the managers of all enterprising roads. To properly maintain equipment such as that mentioned above, it is absolutely necessary to have the repair department equipped with the very best of machinery and tools. It is also essential that the shops be laid out in a proper manner. Other important points are the securing of proper repair material and the right kind of men to do repairs. In the matter of shop construction the building of proper pits is of great importance, as lack of pit room in shops is a great drawback. The writer would strongly recommend that all barns, storage houses, and repair shops be designed for all tracks to be laid over pits, as this not only facilitates repair work, but also motor and truck inspection. It is also well to have a number of pits designed for the removal of wheels. The installation of pit pumps, air hoists, and swinging cranes is also strongly recommended. The use of compressed air is now common in modern electric railway shops for the purpose of operating pneumatic tools, cleaning out motor cases, operating vapor painting, and other purposes.

Patterns, jigs and templets for the manufacture of all repair parts should be procured and kept in the tool rooms of the various departments engaged in the manufacture of the different parts.

The subject of standard equipment in repair parts is a question which the writer considers to be of great importance, and repair men will heartily welcome the day when it will be necessary to keep only one type of repair parts for all equipment. For some years electric railway companies have been endeavoring to secure some uniform system of repairs and repair parts, and their efforts to a certain extent are now being rewarded. This success is largely if not entirely due to the formation of associations which meet at stated intervals for the discussion of methods of maintenance, as well as to the "question box" system, and, of course, much progress has been made by correspondence between companies. This system of exchanging ideas has entirely eliminated the feeling which repair men had some years ago, namely, to say nothing and let the other fellow find out by experience.

We, of the Toronto Railway, are very proud of our shops, and without boasting may say that we have cause to be. Taking into consideration the size of our system, and the number of cars operated, we have shops that are as up-to-date as any in existence. We have endeavored to keep our shops in such condition as to be able to meet any demands which may be made upon them at any future period, within, of course, a reasonable time.

Touching on the question of general shop practice, the field for discussion is so large that it is only possible for me at this time to touch on a very few of the methods in vogue at our shops. First, we will mention the machine shops. This department is equipped with the most modern machinery that can be obtained. Templets and jigs have been manufactured in our shops for the purpose of turning out work with speed and accuracy. In this department, as well as in other departments, the apprenticeship system is in vogue, and we have been able by means of fair treatment to retain the services of our graduated apprentices. These men are so perfectly familiar with the article upon which they are called upon to work that they are able to turn work out much more quickly than would be the case were we to engage men from the outside and break them in. A sufficient number of skilled mechanics from outside sources are engaged to enable us to handle any and all kinds of machine work which may be required in our machine shops.

One of the very important articles which is turned out from this department is the motor brush-holder. All brush-holders go through this department before being used on motors, whether they be new or re-

paired. The proper commutation of current in the armature is one of the very important factors in the securing of efficiency in the motor equipment. By this I mean the proper spacing of brushes, and the angle at which they are set on the commutator. We in Toronto have had a great deal of trouble with our motors, due to the improper setting of brushes, caused by the wooden brush-holder yokes shrinking; and also to the brush-holders being set at the wrong angle to properly follow the natural wear of the commutator. To overcome this difficulty I have had constructed a jig, on which all complete brush-holders and yokes are adjusted before being issued to the motor supply department. This jig consists of a metal bed plate to which is bolted a cylinder, the same size in diameter as the average commutator. In the centre of this cylinder is a post about 4 inches in diameter. The cylinder is slotted to receive a steel insert the same size as a carbon brush and the post is also slotted to allow the steel insert to enter. An adjustable bracket is also bolted to the bed plate to permit of the regulating of the distance between the centres of the different types of motors. The complete brush-holder is then bolted to this bracket, and if correct the steel insert will easily pass through carbon-holder, cylinder and pocket in the slot in the centre part of the jig. By these means proper distances and angles are secured. We use for our brush-holders the best of kiln dried hard maple, which is kept in storage two years before using. This practically overcomes the trouble caused by shrinkage.

A special jig is also used which permits of drilling brake hangers for eight different types of trucks. All hangers of similar trucks are absolutely the same centres. This is very important, as it insures the correct hang and longer life of brake shoes. It also assists in overcoming the chattering of hangers when the brakes are applied.

The setting of a standard for brush-holder spring tension is also important to insure the best results from commutator wear. Too much attention cannot be given to the subject of motor bearings The best of material is none too good for this purpose, as probably no piece of machinery is so subject to abuse as are railway motors, and especially is this true of the bearings. As regards lubrication, oil is rapidly taking the place of grease; in fact it may be safely said that the days of grease lubrication are practically past. All modern motors are designed for oil feed bearings, and several good oil cups have been placed on the market for the older types of motors. I strongly advise electric railway men to look well into the matter of lubrication of equipment, as neglect in this respect leads most directly to losses in the coal pile, and increased operating expenses.

The motor situation may be summed up thus: Be sure of the condition of armature and field windings, have proper gap between fields and armature, have brush-holders correctly set to follow the wear of the commutator, keep bearings well lubricated and motors clean. If attention is given all these matters there is no reason why a motor should be pulled apart more than once in eight months for overhauling, except for some cause, such as lightning or mechanical injury.

In the matter of motor maintenance we in Toronto have made a special study of the causes which lead to motor break-downs, and we have gone to work systematically to overcome these causes. I am pleased to state that the various manufacturing companies have worked heartily and harmonious with us in this matter.

In our shops we are able to trace back to the man who made or repaired any article in the works which does not turn out satisfactory, and this system has given most beneficial results.

Touching on the matter of car records, I cannot too strongly emphasize the necessity of keeping a separate record of every car upon the road. From individual car records quite often it is found that instead of the cripples being different cars, they are the same cars that are continually running in for repairs. Thus you are given an answer to the question, "Which car shall be overhauled next?"

TORONTO RAILWAY COMPANY.

The fifteenth annual report of the Toronto Railway Company, which is for the year ending December 31st last, shows a large increase in the company's earnings over previous years. The gross earnings amounted to $3,109,739.61, an increase of 12.8 per cent. over 1905. The improvements to the power plant and other properties have resulted in a reduction of the ratio of operating expenses to the gross income from 56.8 per cent. for 1905 to 52.9 per cent. for 1906. The consequence is an increase of $276,337.18 in the net earnings over the previous year, making a total of $1,463,224.34.

The Board of Directors of last year was re-elected, and consists of Wm. Mackenzie, Frederic Nicholls, Hon. George A. Cox, Sir Henry M. Pellatt, W. D. Matthews, Rudolph Forget and James Gunn. At the conclusion of the shareholders' meeting the directors met and re-elected Wm. Mackenzie as president and Frederic Nicholls as vice-president.

Mr. Fleming stated at the close of the meeting that 100 new cars are being constructed, half of which number will be ready for use by the first of November, the remainder following as rapidly as they can be turned out.

CHANGING OPEN CARS TO CLOSED.

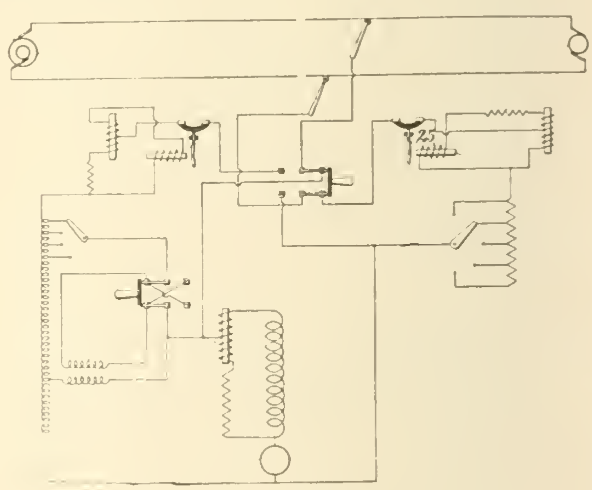
The Toledo Railways & Light Company, of Toledo, is withdrawing practically all of its side entrance open summer cars from service, retaining a very few of them for park service. The increased liability of accidents on account of running boards and the inconvenience of having double equipment is responsible for this change of policy. For future service it is installing a number of Brill semi-convertible cars with low side seats and low windows which slide into the roof. The company owns a number of double truck open cars in good condition, and as rapidly as possible it is converting these into closed cars by framing up the sides and putting in windows. The old benches are used by cutting out a section in the centre and making a centre aisle. While doing this work, the rear platform and hood is lengthened to give the Detroit type of platform. The cost of reconstruction and refinishing into a very satisfactory closed car is said to be less than $350.

INCANDESCENT LAMP TESTS ON ALTERNATING CURRENTS.

At a meeting of the Institution of Electrical Engineers on February 7th, Dr. H. F. Haworth gave the results of some comparative life tests on carbon, Nernst and tantalum incandescent lamps to determine whether the working of such lamps on an alternating-current circuit was in any degree different from that when using continuous current. A series of tests were undertaken by Dr. Haworth, Mr. T. H. Matthewman and Mr. D. H. Ogley, and the results of these tests were embodied in the paper presented by Dr. Haworth. Tables were presented showing the performances under test of the Nernst and carbon incandescent lamps, and a comparison of the average results shows a saving of 57 per cent. in watts per candle in favor of the Nernst lamp. The percentage cost saving is much less than the percentage energy saving on account of the frequent and expensive renewal of glowers and iron resistances. Against the saving in cost the authors placed (1) the much higher capital outlay on the lamp; (2) the large sizes in which it is manufactured; (3) the time it takes to light; (4) the erratic life of the glowers. It must be remembered that these tests are made with alternating currents, and that the Nernst lamp appears to work much better with continuous current. Further tests were divided into three series: (1) Lamps run on their constant normal voltage (230); duration of test, 1,000 hours. (2) Lamps run on a constant voltage (240), about 5 per cent. above normal; duration of tests, 750 hours. (3) Lamps run on a voltage varying continually between 230 and 240 volts, the variation having a period of two minutes. In the first series of tests six lamps, three 16 c.p. and three 32 c.p., of each kind were tested, except tantalum lamps, in which case two 115-volt lamps were placed in series. The Nernst lamps used were 245 volts, 0.25 ampere. The Nernst lamps used were marked 225 volts on the filament and 20 on the ballasting resistance, so that it would appear that they should be run on 245 volts, and it was found that they gave better results on the 240 than on the 230 volt circuit, yet they were the lamps sold for use on the 230-volt mains at Liverpool. In the second and third series of tests two lamps, one 16 c.p. and one 32 c.p., of each make were employed. In all cases the frequency of supply was 50. The general conclusions were as follows: The average of "the average watts per candle" for the 70 carbon lamps tested in all is 4.86; for the eight $\frac{1}{4}$ ampere Nernst lamps tested this average is 4.14, and for the six tantalum lamps 1.97. The ordinary $\frac{1}{4}$ ampere Nernst lamp of commerce is thus about 15 per cent. better than the average carbon lamp, while its life is about 560 hours. The average consumption of the tantalum lamps tested was 60 per cent. less than that of the carbon lamps, and their lives were on an average 330 hours; doubtless the tantalum lamps made now will give much longer lives than these. Though the tantalum lamps, even on these few tests, show a much better efficiency than the carbon lamps, the makers of carbon lamps feeling the competition of the new metal-filament lamps will, without doubt, vigorously turn their attention to the production of a two-watt-per-candle carbon lamp.—Electrical Engineer.

SELECTIVE CONTROLLING DEVICE FOR ALTERNATING AND DIRECT CURRENTS.

The accompanying illustration shows a type of controller equipment designed for use with either direct or alternating current, and so arranged as to prevent the application of power to either of two sets of circuits of an amount or character for which it is not adapted. A double-throw switch (in the center of the illustration) serves for connecting rheostatic control circuits to the motor when direct current is used, and variable-voltage control circuits when the supply is alternating current. An overload circuit-breaker is arranged in series with the rheostatic control circuits, and a similar breaker is connected in the variable-voltage control circuits. In parallel with the tripping coil of each breaker are connected certain combined inductive and non-inductive circuits which are so arranged as to make the direct-current breaker especially sensitive to alternating current and the alternating-current breaker especially sensitive to direct current.



SELECTIVE CONTROLLING CIRCUITS.

By means of this arrangement any alternating current which by accident may flow through the rheostatic control circuits, is caused to divide and one-half to flow through the tripping coil of the direct current breaker, while the normal direct current is allowed so to divide that only a very small part of the total current passes through the tripping coil. When direct current attempts to pass through the variable-voltage control circuits a very large portion of the current is forced through the tripping coil of the breaker, but the normal alternating current is forced to divide equally between the tripping coil and the current in parallel therewith.—Electrical World.

A Straits of Belle Isle Tunnel.—A scheme is formulated by its promoters for constructing, opposite Point Armour, a tunnel, ten miles in length, beneath the Straits of Belle Isle between Labrador and Newfoundland, with the object of expediting railway transit between Quebec and the northeastern coast and of shortening the voyage across the Atlantic. The Newfoundland Government have authorized the Quebec and Lake St. John Railway Company to make a line between the Straits and Blanc Sablon on the Canadian and southern side boundary of Labrador, and will, it is stated, subsidize the undertaking to the extent of $75,000 per annum. The proposed line will run for a length of 30 miles through the island to Hare Bay, at the northern extremity, which is distant about 1,800 miles from Ireland. The cost of the tunnel is calculated at £1,200,000.—The Builder.

TELEGRAPH and TELEPHONE

APPLICATION OF THE TELEPHONE TO RAILWAY SERVICE.

At a recent meeting of the New England Street Railway Club in Boston, Mr. C. J. H. Woodbury, of the American Telephone & Telegraph Company, gave an able and interesting discussion of railway dispatching, with special reference to the facilities afforded by the telephone in extending the zone of mental effort. Because it is the only electrical device which can be used without skill the telephone is rendered of especial value in the control of railway transportation, said the speaker.

In speaking of the early history, Mr. Woodbury called attention to the fact that electricity was considered for railway signaling long before the devices for its application were invented, for in 1828 Edward Davy, of England, made a proposition for the application of electrical signals for indicating the direction of trains, whether stationary or in motion, which appears to be the first available record ou the application of electricity to train movements.

The Wheatstone telegraph was applied for signaling on a cable railway at Blackwall, England, in 1835. On the whole, the application of electricity for the communication of intelligence in both directions appears to have origiuated with the use of the Morse telegraph in 1850 on the Erie Railroad by Charles Minott, general superinteudent, although it is claimed that previous to that date railroad men had availed themselves of the telegraph to direct the movement of trains, but his work on the Eric Railroad included the systematic dispatching of trains. This, with steam railroads, has been developed into a most systematic and thoroughly organized department, which is an essential portion of the operation of every steam railroad.

Of late years the telephoue has taken the place of the telegraph to a very material extent, and its use is rapidly increasing, said the speaker. The facility which it furnishes for the instantaneous reply, and the conference over matters requiring a preseutation of facts at one end and the exercise of executive action at the other without the interposition of skilled operators, is of great value, especially on occasions of emergencies.

The telephone is admirably suited for applicatiou to existing telegraph plant iu railway service, for its attachment to such lines does not interfere with the use of the telegraph, uor does the simultaneous use of the telegraph affect the transmission of speech by telephoue. This dual use of the same wires for composite systems is accomplished in a simple manner by insertion of choke coils at the terminals, and also bridging coudensers around the telegraph relays. These condensers will transmit the alternating currents used by the telephone bell and the uudulatory curreuts of the telephone, but they do not conduct the direct currents used in telegraphy. That is, the condensers serve in the place of conductors for telephone service, aud as insulators for telegraph usage.

These composite sets were first commercially used iu New England by the Central Vermont Railroad, and their application rapidly extended to a number of steam railways throughout the country.

The manifold applications of the telephone are indicated by some of the railroads which also have connection with the miuing of coal, and their private branch exchanges not only counect with the offices at the headquarters of various divisions of the railroad, the operation of trains, but also extend down into the coal miues and out to the docks where the coal is shipped, and even connected to telephones in the cabins of the vessels transporting coal, or the tugs which tow the coal barges. On the Mexican Central Railroad all of the cabooses are equipped with telephones, so that all freight trains may be at any time in communication with the superintendent's office, in the same manner that the wrecking cars of steam railroads are equipped with telephone which can be attached temporarily to wires of telephone lines near the road, by means of rods carrying wires ending in hooks, and in that manner coming in communication with the supervising officers. Many other interesting applications were cited.

Steam has beeu concentratiug people into cities from the country for many years, said Mr. Woodbury, but electricity is distributing them back into suburbs, where they may live under freer conditions of light and air, with more hygienic surroundings, and its beneficence is establishing health and longer life for thousands upon thousands who must otherwise be crowded into congested parts of cities, thereby solving many of the complex problems threatening the great municipalities. After detailing some of the advantages of the electric railway, the speaker continued:

In the early days of electric railroads, when the motor was merely a substitute for the horses on the same cars, and even at similar speed, there was not the requirement of any signaling system more than the unfilled need which had already existed in the case of horse cars, but with the expansion of the carrying capacity of a road both as to size of cars and speed of propulsion, and, above all, the long distances of the inter-urban roads, conditions became radically changed and were comparable to those of the steam roads. This development of the transportation facilities became so much more rapid than that of the signaling that the early electric roads were afflicted with a number of mishaps which gave rise to many serious apprehensions as to the advisability of this change of power.

The application of the telephone for train dispatching has resulted in a marked ecouomy of both plant and operation in that the ability of the superintendent to be informed as to the position of the various cars and to communicate with their operators gives a greater service efficiency to the road. Single track railways in sparsely settled districts can be operated at an efficiency which should otherwise require a double track road, merely by the use of the telephone for dispatching, because in case of cars failing to join at meeting points when they are due, they may, under this direction, proceed to another turnout. In case of failure to meet at scheduled turuouts, there is not the risk of eollision by one car running wild to the next switch. Brief meution was made by the speaker of recent occurrences on electric railways where the telephone was the means of saving time, property aud life.

There are three types of application of the telephone to railway dispatching:

(1) Fixed telephoue sub-statious iu booths placed at suitable points along the line.

(2) Jack boxes at poles to which portable telephoues, carried iu the cars, may be hung aud connected for temporary use.

(3) Portable telephone sets hung upon the front of the car, whose vestibule platform serves as a booth, aud attachment made by flexible wires to jacks at numerous poles along the line.

On some railway lines the method of counecting a telephone on the car with the line is uot by means of a jack at the side of one of the poles, but by a long, slender rod, carrying the wires, which may be hooked upon the main lines at any place.

The first method does not differ from arrangements of telephone booths, with which all are familiar, except in minor details, and does not require explanatiou. Portable sets are generally preferred to fixed sets for long mileage and few cars.

Jack boxes on the pole must conform to numerous conditions, not merely to be shot-proof or fool-proof against meddlesome people, but also they must not afford shelter for hornets or other insects of perhaps less virulent disposition, but which impede any such apparatus by the nests which they make; they must also be proof against damage by rain or snow.

The telephone wires should be strung below lighting or power wires and well insulated at its point of support. The lines of such telephones must be transposed at least once in every eight poles, in order to prevent uoises on its circuit, induced from the wires in its vicinity carrying disturbing currents.

When two telephoue circuits are on the same liue, the transposition must be not only alternating the relative positions of the wires of one circuit to the other, but also of the two circuits.

When the spring jacks in an iron box attached to a pole are connected to a common battery signaling system, the two plugs on one handle are of different size, so that they cannot be inserted with wrong poles.

Western Canada

WINNIPEG FEES FOR ELECTRICAL INSPECTION.

The city of Winnipeg have not heretofore charged for electrical inspections, but the work has grown to such proportions that it has been deemed advisable to make a small charge. The following schedule of fees has been recommended by Mr. F. A. Cambridge, City Electrician:

For each permit to instal wiring or fittings, or to alter or repair same whether for lighting or motors, etc. .... 50c.

For each certificate of inspection of wiring only, 50c.

For certificate of wiring and permit to use current, the following charges to apply:

FOR INCANDESCENT LIGHTS.

Size of Installation.	Coverings, Wiring and Fittings Complete.
Up to 15 lights	50
16 to 25 lights	75
26 to 50 lights	$1 00
51 to 75 lights	$1.25
76 to 100 lights	$1.50
101 to 125 lights	$1.75
126 to 150 lights	$2.00

Every additional 25 lights or fraction thereof, Nernst lamps to be classified as incandescents, 25 cents.

In case of covering, wiring only or fitting only, the following rates to be adopted:

Size of installation.	Cost.
Up to 15 lights	$ 50
16 to 25 lights	50
26 to 50 lights	50
51 to 75 lights	75
76 to 100 lights	1.00
101 to 125	1.25
126 to 150	1.50

Every additionad 25 lights or fraction thereof, Nernst lamps to be classed as incandescents, 25 cents.

ARC LIGHTING.

For arc lighting the following rates to prevail:

Size of installation.	Covering, Wiring and Arc Lamps complete.
One arc lamp	$ 50
Two arc lamps	75
3 to 4 arc lamps	1.00
5 to 8 arc lamps	1.25

For each arc lamp over eight, each mercury vapor lamp to be classed with arc lamps.

For covering wiring only or arc lamps only the following rates to prevail:

One arc lamp, 50 cents.
Two arc lamps 75 cents.
Three to four lamps, $1.00.
Five to eight lamps, $1.25.
For each arc lamp over eight, each, 10 cents.

Mercury vapor lamps to be classed as arc lamps.

If arc lamps are installed along with incandescents, one half above fees shall be charged, provided inspection is made at one and the same time, but not otherwise.

Provided that should an installation not be completed and installed in accordance with the provisions of this by-law on date called for by the applicant, a further fee of .50 per visit shall be paid for each installation inspected.

ELECTRIC MOTORS AND GENERATORS.

For each permit to use current a fee of .50 for each motor shall be charged. Provided that should an installation not be completed and installed according to the provisions of the bylaw on the date called for by the application, a further fee of .50 per visit shall be made for each motor inspected.

In the case of installation of private generating plants, fees shall be charged based on the capacity of lights or motors installed with an addition of .50 for each generator or transformer installed.

Portable fan motors to be charged one half motor rate if inspected along with other work on same premises.

For sign work—Decorative wiring, whether temporary or not, a minimum fee of .50 shall be paid for each installation under fifty lights and an additional fee of .50 for each additional 50 lamps or fraction thereof.

A fee of .50 per hour shall be paid for services of each inspector on inspections made on request of owners or users of same.

ELECTRICAL INSTALLATIONS.

Mr. F. A. Cambridge, City Electrician of Winnipeg, furnishes the following statement of electrical installations inspected during the three months ending January 31st, 1907:

Month.	Permits for Wiring.	Permits for use of Current.	Interior Arc Lamps Installed.	H. P. Motors and Dynamos Installed.	Outlets Wired.	Inc. Lamps Installed.
1906.						
November	465	496	2	1,269	5.626	6,842
December	322	338	6	81	1,800	4,881
1907.						
January	156	226	4	161	2,727	2,870
Total	943	1,060	12	1,511	10,153	14,593
Previous three months	1,603	1,559	31	463	14,804	18,179

THE T. EATON COMPANY'S PLANT.

One of the finest electrical plants in the city of Winnipeg is that owned by the T. Eaton Company at their store on Portage avenue. Besides elevators, pumps, irons, etc., this plant supplies light for 246 arc lamps and over 3000 incandescent lamps.

The motive power is steam, there being four boilers of 250 h.p. each, with a pressure of 140 pounds to the square inch. The boilers were manufactured by the Heine Safety Boiler Company and consume 100 tons of coal a week.

The lighting plant consists of two direct current generators of 200 k.w., 1,600 amperes, speed 200, and two generators of 100 k.w., 800 amperes, speed 275, coupled to Robb-Armstrong engines made by the Robb Engineering Company. The generators were supplied by the Canadian Westinghouse Company, of Hamilton.

The building measures 262 x 146, and its capacity is 3,315,000 cubic feet. Altogether there are some 42 motors about the place and a set of irons. The average aggregated power in use is about 430 h.p.

The pumps are the compound duplex and measure

14 x 20 x 11 x 18. There are in all 11 hydraulic elevators—six passenger and five freight, and a new addition is being added to the building, in which there will be five more elevators.

A remarkable water supply is given by a 6-in. well, 209 feet deep, which is able to give 3,000 gallons an hour.

The method of heating is the Webster system. The average distribution of power is about as follows: Heating, 109 h.p.; lighting, 65 h.p.; elevators, 43 h.p.; pumps, 36 h.p.

The chief engineer of this plant is Mr. Robert Hutt.

ELECTRICAL PLANT OF THE WALKER THEATRE, WINNIPEG.

The Walker Theatre in Winnipeg, which has just been completed, is probably the best equipped and the only absolutely fire-proof theatre in Canada. The building was erected by the Canadian White Company, the design being the work of Mr. H. Stone, architect, Montreal, assisted by Mr. L. T. Bristow, of Winnipeg.

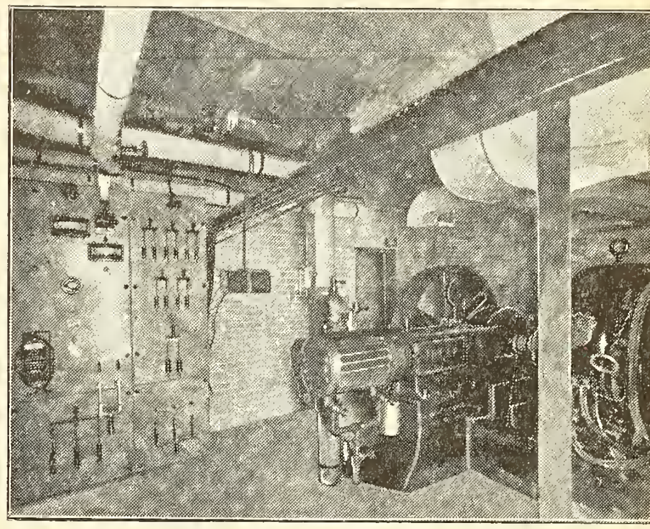
One of the special features of the theatre is the electrical plant. The lighting is provided by means of two direct connected generators, 100 k.w. and 65 k.w. respectively, supplied by Allis-Chalmers-Bullock, Limited, Montreal. As a precaution there is also a service from an outside source of power, so that in the event of anything going wrong with the local plant it can be immediately thrown on to the outside service, and vice-versa.

The total number of lights supplied by this plant is about 5,400, consisting of 1,000 stage border lights, 250 foot lights, 150 procenium lights, all of which are incandescent, also 4,000 incandescent lights in the house and 4 flaming arc lamps.

The wiring throughout the building is entirely encased in iron conduit, the contract for this work, including the switchboards and fittings, amounting to over $10,000.

The main switchboard is on the stage. In addition to this is a secondary one in the box office, with an independent supply, so that certain lights in all parts of the house can be thrown on at a moment's notice.

Great precautions have been taken against fire—the steel work is encased throughout in concrete or terra-cotta. The procenium opening, which is 35 feet wide, is protected by a fine asbestos curtain, fitted into steel pockets at either side. Above the stage are two large skylights, which operate automatically, so that if perchance the scenery were to catch fire, these skylights being thrown open, the smoke would be driven through them instead of into the auditorium.



Electric Plant of Walker Theatre, Winnipeg.

The ventilating apparatus consists of two fans, 7 feet in diameter and 3 feet wide, which draw the air from above the roof through galvanized iron ducts to the basement, where it passes through filters, consisting of coke and running water, after which the air passes a network of steam coils until a desired temperature is acquired. The fans have a capacity of driving 40,000 cubic feet of air per minute.

The chief engineer and electrician is Mr. J. T. Blake, whose experience fully qualifies him for the position.

Messrs. A. C. Leslie & Company, Limited, Montreal, have published a souvenir booklet giving a short account of the history of the company, which has now been in existence for over 40 years. The business of this firm has grown very rapidly, and now extends from the Atlantic to the Pacific.

To decide between turbine or reciprocating pumps for a given service a good rule is to assume that where the head in feet is greatly in excess of the quantity to be delivered in gallons per minute, a reciprocating pump will give better results.

Under varying loads, the induction motor behaves very similar to the shunt-wound direct-current motor. In both the armature current is due to the difference between an applied and a counter electromotive force, the former being delivered from the line through the brushes in the one case and by induction in the other.

Tee 60,000-volt transmission line of the Edison Electric Company of Los Angeles is now practically finished. It runs from a 25,000-h.p. hydro-electric station on the Kern river, a distance of 125 miles, to Los Angeles, and consists of six cables carried on steel towers from 30 to 75 feet high, and furnished with insulators weighing 50 lbs. apiece, and about 3 feet high.

AN INTERESTING EXHIBITION IN FRANCE.

There is shortly to be held in Lyons an exhibition of the many new electrical devices invented for domestic uses. No motor will be shown exceeding one horse-power. There will be motors for embroidering, for sewing and knitting machines, ventilators, vacuum carpet and rug cleaners; also machines for house cleaning and floor polishing, and small electric-run carts and electrical arrangements for turning spits in cooking.

It will prove the practical uses to which electric power is being put abroad. When adopted, the housewife will find her work a simple matter of attaching a wire to an incandescent light and turning on the key—and her dressmaking bills will be reduced by the simplicity of the electric motor. All through the day, electricity will be saving her time, trouble and money.

Some of the extraordinary smaller uses of electricity can be observed in the skyscraping Traders' Bank Building, in Toronto. Wherever one turns there is something that makes things easier in the way of electricity. From the electric elevator to the electric mail shute, the up-to-date application of this mysterious power is encountered on every hand. In giving the contract, The Canadian Westinghouse Company, which was selected to supply the electric apparatus, was instructed to give full attention to these convenient and step-saving details.

It may be safely predicted that it won't be long before the helpfulness of electricity is embodied in the homes as well as the offices of the civilized world.

Messrs. Allis-Chalmers-Bullock, Limited, have, through their Vancouver office, sold to the Vancouver Milling & Grain Company a 100 horsepower, 2,200 volt, 3 phase, 60 cycle, induction motor, complete with starting apparatus. This motor is to be used to drive all the mill machinery.

TRADE NOTES.

Tho Prepayment Electric Meter Company, of Peterboro', Ont., are understood to have closed negotiations by which Allis-Chalmers-Bullock, Limited, of Montreal, will handle the entire output of their factory and act as selling agents for the company. The Prepayment Electric Meter Company will now proceed to build a factory, which is expected to give employment to upwards of 100 persons.

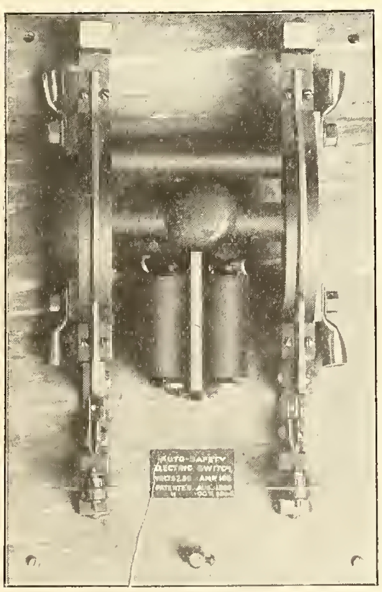
It is announced that the Canadian Westinghouse Company will build a large extension to their works at Hamilton, Ont. The business has increased so rapidly that their existing plant, built only a few years ago, has been found inadequate, and it is therefore proposed to complete the extensions as quickly

Among the patents recently secured by Mr. Owen N. Evans, of Montreal, is one for an incandescent lamp bulb, the invention of Mr. D. F. Campbell.

A deputation representing the town of Bracebridge, Ont., recently waited on Hon. Frank Cochrane, Minister of Lands and Mines, for the purpose of securing certain rights to High Falls and Wilson Falls, on the north branch of the Muskoka River, with a view to the development of electric power. The town has already developed about 1,000 horse-power, which is now being utilized. The two falls mentioned will probably develop 1,800 horse-power.

"A good idea of the extent to which engineering work in all its branches is now being carried on can be formed when I say that we had over 600 appointments offered to the sixty members who graduated last session." This statement was made by Prof. Bovey, Dean of the faculty of applied science of McGill University.

The General Electric Company of Sweden, through their Canadian agents, Messrs. Kilmer & Pullen, McKinnon Building, Toronto, have supplied the Municipality of Owen Sound with a 375 K.V. A. 2200 volt generator for direct connection to a Robb-Armstrong, cross compond high speed engine. This set was put in operation early in February.



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Electrical Apparatus For Sale

1 75 K. W. 2200 Volt Stanley Alternating Generator, with 2½ K. W. Exciter.
1 40 H. P. Induction 133 Cycle.
2 30 " " "
3 15 " " "
1 5 " " "
1 3 " " "

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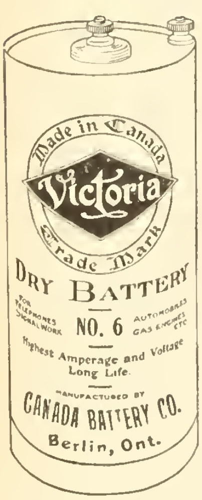
Brantford, Ont.



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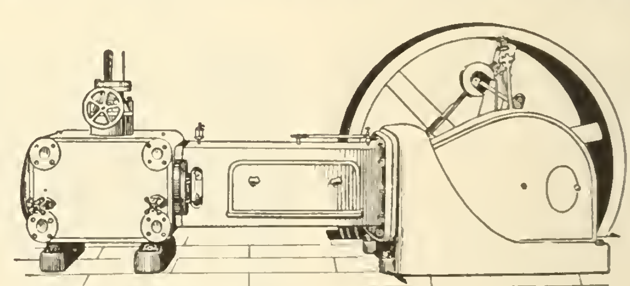
LONG STROKE ENGINES



We manufacture a full line of sizes of the style of engine shown in cut, either Corliss type or with Sweet balanced valve.

They are fitted with Robb-Armstrong automatic governors, giving close regulation and high economy.

Oil is forced through piping to all bearings, ensuring positive and copious lubrication.

They are built on the interchangeable system and duplicate parts exact in fit can be supplied on short notice.

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NOTES.

Mr. Justice Britton has dismissed the appeal of the Berlin and Waterloo Railway Company from the award of the arbitrators, Judge Jameson, Judge Morgan and J. M. Scully. This award given on December 29th, 1906, allowed the city of Berlin to take over the railway on the payment of $75,200.

The following comparison respecting the operation of the Montreal and Toronto Street Railways last year will be found interesting :

	Montreal Ry.	Toronto Ry.
Gross	$ 3,100 48	$ 3,100,739
Operating expenses	1,850,716	1,646,515
P.c. expenses to gross	59.69	52.94
Net	1,249,766	1,463,224
Net income p.c. of capital	17	29.90
Fixed charges	163,599	217,199
Dividends	700,000	460,241
Surplus	524,770	1,970,653
City p.c.	178,418	348,963
Passengers carried	76,356,099	76,106,932
Transfers	24,516,067	28,159,558
Total passengers carried	100,872,166	104,266,490

The utilization of alcohol in internal combustion engines has been found feasible, by a number of investigators, by admitting in liquid form directly over a disc valve, the liquid passing to the cylinder through a series of brass screens. With this method of fuel admission, engines of standard construction as arranged for operation with gasolene fuel, are said to start easily and run freely and without smoke or odor. Attempts toward the use of any form of carburetor, in which vapor of the alcohol is to be taken up by the air drawn into the cylinder, do not seem to have proved scccessful without some means of forced vaporization, such as heating or atomizing.

PERSONAL.

The death occurred in Schenectady, N. Y., last month of Mr. George Brebner, a graduate in applied science in the School of Practical Science, Toronto.

Myron Edward Evans, Assoc. M. Am. Soc. C. E., president of the Cape Breton Railway of Canada, was killed in the wreck on the New York Central & Hudson River R. R. at Bronx Park, New York City, February 16. He was a graduate of Rensellaer Polytechnic Institute, class of 1895.

Mr. W. K. McNaught, who represents North Toronto in the Legislature, has been appointed a member of the Hydro-Electric Power Commission of Ontario, to replace Mr. Cecil B. Smith, who recently tendered his resignation. Mr. Smith will continue to act as consulting engineer for the Commission, which is now composed of Hon. Adam Beck, the chairman, Hon. J. S. Hendrie and Mr. W. K. McNaught, M.P.P.

SPARKS.

Mr. M. Peterson, secretary Winnipeg Board of Control, has invited tenders for street lighting supplies, including 200 arc lamps and cut-outs, two 100-light arc regulators, and twelve lightning arresters.

A project is under consideration at Vernon, B.C., to utilize Shuawp Falls for power purposes. It is proposed that the city shall joint a private company to undertake the work, which is expected to cost $100,000.

Messrs. Galt & Smith, consulting engineers, Toronto, are asking for tenders by April 15th for the supply and installation of an electric lighting system for the town of Battleford, Sask. Plans at the office of the secretary-treasurer, Battleford, or the engineers at Toronto.

The municipal power plant at Gravenhurst, Ont., will probably cost about $40,000. Additional contracts were awarded last month, the Jenckes Machine Company, of Sherbrooke, Que., securing the exciter wheel and Garrioch, Goddard & Company, of Ottawa, the lightning arresters.

The British Columbia Power & Electric Company, Limited, have filed an application to the Water Commissioners of New Westminster, B.C., for 3,000 miners' inches of water to be taken from the Squamish River and Aejeekamish River. The company propose developing the power for the generation of electricity.

A special committee was appointed by the City Council of Peterboro', Ont., to enquire into the purchase of the business of the Peterboro' Light & Power Company. The company have agreed to accept $207,500 for the electric light and gas plant as existing on January 1st, 1907, and the special committee has recommended that an expert be engaged to report on the value of same.

Mr. W. R. Bonnycastle, electrical engineer, has recently been engaged by the Stave Lake Power Company, of Vancouver, B.C., to take charge of the proposed extensions of their work during the present season. The company have invited tenders for hydraulic and electrical equipment sufficient for the generation of 10,000 horse-power. The first coffer dam is already in place and operations can now be carried on more rapidly.

The Dominion Power & Transmission Company, organized to acquire the Hamilton Cataract Power, Light & Traction Company and other concerns, have elected the following officers:—President, Hon. J. M. Gibson; Vice-President, James Dixon, Hamilton, and John Knox, Brantford; Secretary and General Manager, W. C. Hawkins; Treasurer, J. R. Moodie. as possible.

It is reported that a project is under way by the British Columbia Electric Railway Company to take over the Esquimault & Nanaimo Railway, on Vancouver Island, and convert it into an electric road. The total length of this road is about 85 miles, and it is at present the only railroad on the Island. Engineers are said to be out at present, endeavoring to locate a suitable water power. Should the project become a fact, it will doubtless be a couple of years before the electrification of the road is completed.

The Cove Hydro-Electric Company propose to harness the Tantarman River near Sackville, N.B., for the purpose of generating electric power for transmission to Amherst, Sackville, Moncton, Dorchester, and other towns. The company has been incorporated in Maine, with a capital of $2,000,000. Mr. Frank R. Kimball, of Boston, is the president, and Mr. Wilbur J. Webb, secretary-treasurer. Mr. George H. Cove and W. S. Cove, of Amherst, N.S., are also interested. It is understood that three concrete dams will be necessary, and that work will be begun this spring.

The Simonds Canada Saw Company, Limited, of Montreal, are installing a 600 B.H.P. producer gas plant, to be used for driving the gas engine and providing gas for the various furnaces in their works. The first of the large engines, a four-cycle single cylinder horizontal unit of 150 B.H.P., is now in course of installation. It is what is classed by English builders as "special electric light type," having extended crank shaft with outer bearing and only one fly wheel of extra large diameter, and weighing ten tons. The entire plant is being supplied by the Producer Gas Company, 11 Front street east, Toronto, of which Mr. G. P. Wallington is manager.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

SEVENTEENTH YEAR. No. 4. | TORONTO, MONTREAL — APRIL, 1907 — WINNIPEG, VANCOUVER | PRICE 10 CENTS $1.00 PER YEAR.

MOONLIGHT SCHEDULE FOR MAY

Date.	Light.	Date.	Extinguish.	No. of Hours.
May 1	7 30	May 2	0 30	5 00
2	7 30	3	1 30	6 00
3	7 30	4	2 20	6 50
4	7 30	5	3 10	7 40
5	7 30	6	3 45	8 15
6	7 30	7	4 10	8 40
7	7 30	8	4 10	8 40
8	7 30	9	4 10	8 40
9	7 30	10	4 00	8 30
10	7 30	11	4 00	8 30
11	7 30	12	4 00	8 30
12	7 40	13	4 00	8 20
13	7 40	14	4 00	8 20
14	7 40	15	4 00	8 20
15	7 40	16	4 00	8 20
16	7 40	17	4 00	8 20
17	7 40	18	3 50	8 10
18	10 50	19	3 50	5 00
19	11 30	20	3 50	4 20
21	0 00	21	3 50	3 50
22	0 30	22	3 50	3 20
23	1 00	23	3 50	2 50
24	1 30	24	3 50	2 20
25	No Light	25	No Light	
26	No Light	26	No Light	
27	No Light	27	No Light	
28	7 50	28	10 10	2 20
29	7 50	29	11 20	3 30
30	7 50	31	0 20	4 30
31	7 50	June 1	1 10	5 20
		Total		172 25

The ratepayers of Berlin, Ont., have reaffirmed their faith in municipal ownership of public utilities by carrying a by-law on April 4th to purchase the Berlin & Waterloo Street Railway Company's system, the price to be paid being $75,200, exclusive of the costs of arbitration. The town now owns the street railway, gas, electric light and waterworks systems.

Please mention the CANADIAN ELECTRICAL NEWS when corresponding with advertisers.

SPARKS.

The Barber Electric Company, of Vancouver, B.C., have secured the contract from the C. P. R. for the complete wiring and electrical equipment of the addition to the company's hotel at Lake Louise.

The Great Falls Power Company have offered to sell the city of Portage la Prairie, Man., 1,000 horse-power of electrical energy at $25 per horse power per year, with a reduction to $22.50 if 10,000 horse power is taken, and a still further reduction to $20 for an additional 10,000 horse-power. The company will undertake to deliver the power within two and one-half years. Mr. D. Sinclair is the secretary-treasurer.

To prevent accidents in the King street subway, the Toronto Railway Company have installed a protecting hood over the street railway wires, which is calculated to prevent the pole of the car getting off the wire and leaving the car helpless and unlighted in the subway. If the pole should get off, the new appliance will continue the movement of the car. A similar protective device will shortly be installed at railway crossings.

SPARKS.

The Trinidad Electric Company, Limited, have just declared a quarterly dividend at the rate of 5 per cent. per annum.

The annual report of the Canadian General Electric Company, presented last month, shows net earnings for the year 1906 of $853,675.16, or about 18 per cent. on the capital cost.

The annual report of the Canadian Westinghouse Company, Limited, of Hamilton, Ont., for the fiscal year ended December 31, 1906, showed net earnings of $346,961, an increase of $126,416 as compared with the previous year.

The Ontario Railway and Municipal Board has fixed April 25th for a further test of street car fenders. Messrs. Wyse and Middlemist, consulting engineers, Toronto, are the experts in charge of the tests.

The electric lighting plant of the Sackville Electric Light & Telephone Company has been purchased by Messrs. Charles W. Facett and Charles Pickard. It is understood that the plant will be remodelled.

The ratepayers, of Shelburne, Ont., have approved of a by-law to issue debentures for $50,000 for the purpose of acquiring a water power on Pine River, in the Township of Mulmer, and installing an electric plant.

CLASSIFIED INDEX OF ADVERTISERS.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XVII. APRIL, 1907 No. 4

Gas, Gas Engines and Gas Producers*

By J. Seton Gray, S. Can. Soc. C. E.

The thermal efficiency of a modern steam plant is about 10 per cent., and that of a gas engine plant about 20 per cent. This is the principal reason for the large amount of work that has been done in recent years on the gas engine. Again, while gas can be manufactured in a gas producer for about three cents per 1,000 cubic feet, city lighting gas costs between 50 and 100 cents per 1,000 cubic feet. This explains why so much attention is being paid to the development of the gas producer for the making of power gas.

The many methods adopted for the production of power gas may be divided into three general classes:

1. When a carbonaceous substance such as coal is heated in a closed retort, gases are given off which may be collected and used for power. This method is that at present in use for the manufacture of illuminating gas.

2. If steam be blown through a mass of incandescent fuel, a combustible gas is produced. In this process the fuel is kept incandescent by a blast of air, the steaming and blowing periods being intermittent.

3. If steam and air together be uninterruptedly blown into incandescent fuel, a gas, containing hydrogen and carbon monoxide, is produced continuously. The amounts of steam and air are regulated so as to keep the fuel at a fairly constant temperature.

Gas produced by the first method, while generally of high calorific value, is costly, as already mentioned. Water gas, produced by the second method, is much cheaper; but as it contains much hydrogen is a very inflammable gas, and on this account cannot be used with the high compression pressures now employed in gas engine practice. These high pressures are necessary if a high efficiency is required of an engine.

The third method, however, gives a cheap gas, well suited for gas engine work, and will be treated more fully in this thesis.

Nearly all fuels containing carbon can be used for the production of producer gas. It must be noted, however, that if the gas is going to be used in a gas engine cylinder, it must be of uniform quality. It must also contain no tar or other impurities in order to avoid trouble with the valves.

To Mr. Dowson we owe the first successful producer gas plant. His plant was designed to work with anthracite coal. This coal is non-caking, and, being nearly pure carbon, contains very few condensible hydrocarbons or tar. It is therefore an ideal fuel for the gas producer.

As this producer embodies in the best way the fundamental principles necessary for the production of gas from solid fuel, it will be described here.

Fig. 1 is a diagrammatic section of a Dowson Gas Producer, taken from "The Gas and Oil Engine," by D. Clerk. As may be seen, the producer consists of a cylindrical casing A, lined with fire-brick, and having at the bottom fire bars B, above a closed ash pit C. The upper part of the generator is closed by a metal plate, on which is mounted a fuel hopper D, having an internal bell valve, E, operated from the outside.

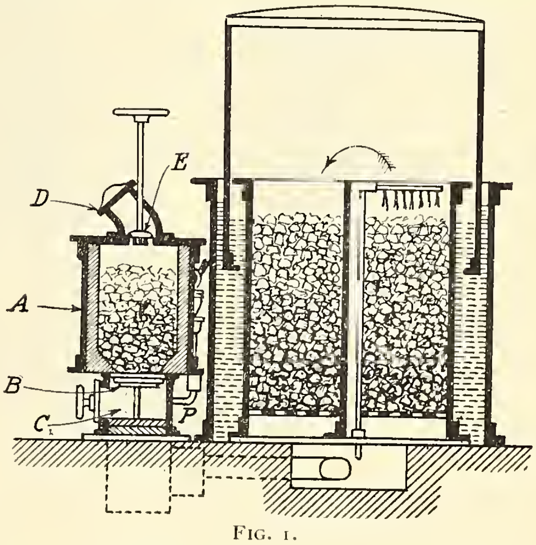


Fig. 1.

To begin operations, the upper cover is removed from the hopper D, the bell valve is opened; a fire is built upon the bars B, and air forced through it by the steam jet N and the pipe P. Fuel is slowly added from above till the whole mass is incandescent, and fills the producer to a depth of about 18 inches at least. During this heating process, gases are given off by way of the open hopper and are ignited there. Care must be taken not to inhale this gas. (It contains much CO and is very poisonous, but when burned it is harmless.) When the fuel is incandescent the inner and outer valves of the hopper are closed, and the gas flows by a pipe through cooling and scrub-

*Paper read before the Mechanical Section of the Canadian Society of Civil Engineers.

bing devices, finally finding its way to the gas holder through the coke scrubber formed within it. From the gas holder the gas flows through another scrubber, as shown by the arrow, and thence to the engine.

In 1895 Renier, a Frenchman, after much experimental work with a Dowson Gas Producer, succeeded in making the engine draw its own supply of gas direct from the gas generator, without the use of a gas holder. While this plant was not a commercial success, it was the forerunner of the modern suction gas producer.

The Dowson Gas Producer has already been described. The following is a description of a suction gas producer; the difference between the two systems may be seen from the descriptions: The adjoining sketch (Fig. 2) shows the general construction of this piece of apparatus. To set it in operation a fire is built on the grate. The door at the front of the producer allows this to be easily done. A quantity of paraffine waste, or other combustible material, is placed inside the generator, and lighted. Broken wood is then added through the hopper at the top, and this is followed by coal until a bright fire is burning. The air for combustion is supplied by a small hand fan B. As soon as the fire is burning brightly the water necessary for the production of the gas is turned on.

This gas is tested by opening a small test cock A, and applying a light. If the gas burns with a blue flame it is ready for use. The gas is then allowed to enter the scrubber B, and to pass through the expansion box to the engine. Before being allowed to enter the engine the gas is again tested, and if it still burns with a blue flame the engine may be started. The hand fan is stopped as soon as the engine starts work, and thereafter the whole plant becomes automatic.

During the suction stroke of the engine a vacuum is set up in the engine cylinder. To fill this vacuum air and steam are drawn into the generator, are there turned into combustible gases, which pass through the scrubber to the engine.

For the production of the necessary steam a water supply C is fixed to the generator. This supplies water to the vaporiser D. This vaporiser is just a pipe perforated with a number of holes. Every time the engine draws gas, which it does in proportion to the load, a small quantity of water is drawn out of the vaporiser, falls on a quantity of hot refractory material E in the casing, and is there converted into steam. This steam is caught up by the current of air drawn in at the air valve. The mixture of air and gas passes round the casing to a space F under the fire bars, from whence it is drawn up through the body of incandescent fuel, where it is turned into gas. The gas passes from the generator through a water seal at the bottom of the coke scrubber, passes through the closely-packed coke, where its tar and other impurities are extracted, and then goes to the engine cylinder. A continuous stream of water is allowed to fall in a spray over the coke, whereby the gas is cooled to the normal temperature.

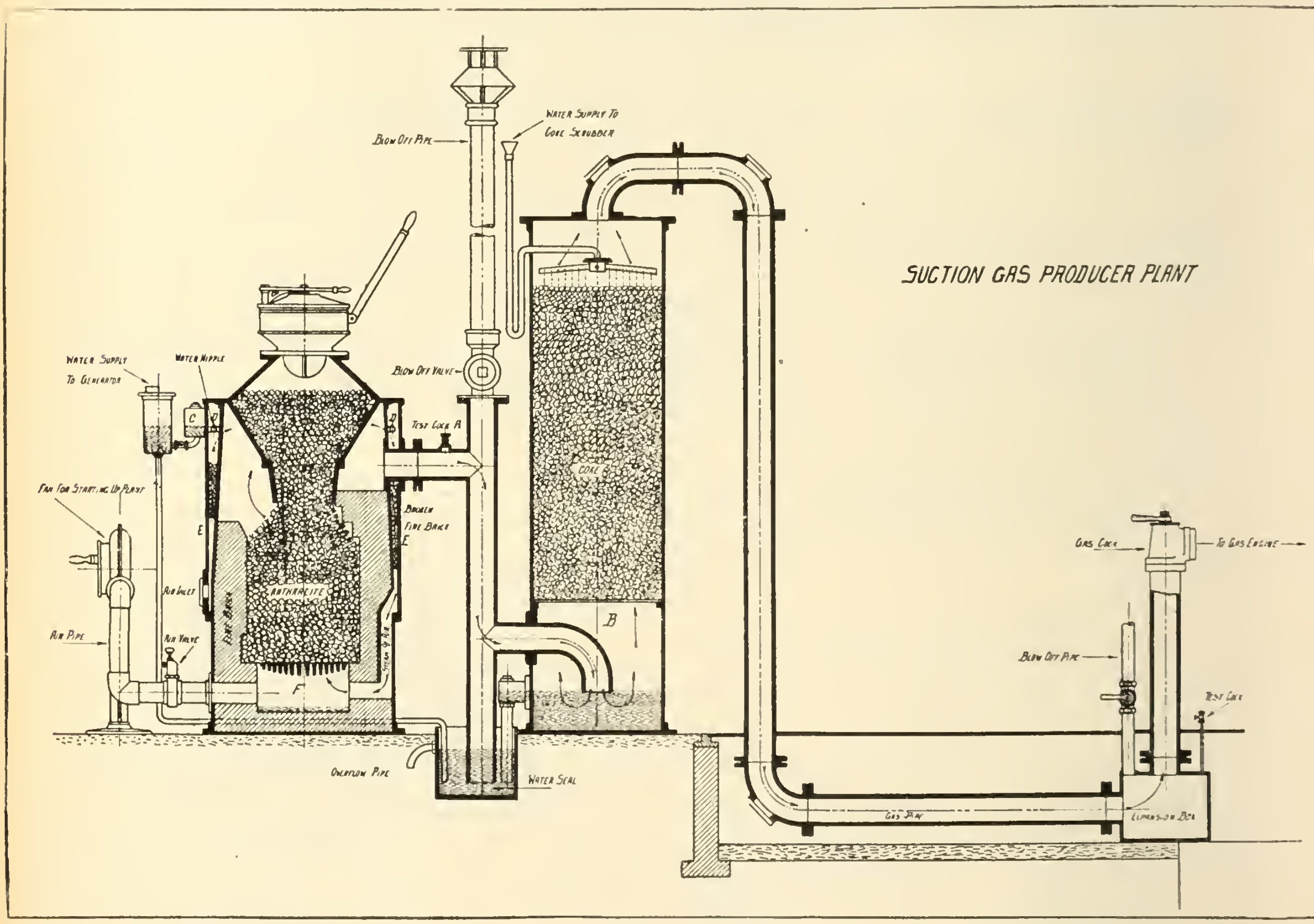


Fig. 2.

The theory of the chemical action that goes on in the gas producer is as follows: When air comes in contact with glowing carbon we get, first of all, the burning of the carbon to form carbon dioxide, according to the equation $C + O_2 = CO_2$. Now, carbon at a high temperature is a very strong reducing agent, so

when the CO_2, already formed, comes in contact with the mass of glowing carbon through which it must pass, the CO_2, carbon dioxide, is reduced to CO, carbon monoxide, according to the equation $C + CO_2 = 2CO$. This carbon monoxide is a combustible gas, very poisonous, and can be used in the gas engine.

When steam comes in contact with glowing carbon, it is reduced by the action of the carbon to CO and 2H, according to the equation $C + H_2O = H_2 + CO$.

The producer plant last described is known as the suction plant, because it is kept in continuous operation by the suction stroke of the engine. Another plant also in common use is known as the pressure plant. A well-known example of such a plant is the Dowson plant, already described. The chemical reactions in this case are exactly similar to those already described when dealing with the suction producer. The principal differences between the two systems are that the pressure system requires a steam boiler in which to generate the steam required for operation, also that with this system a gas holder, in which to store the gas, is required.

There is one serious objection to the pressure system which is not found in the other system. The whole producer is under pressure. If, then, there are any leaks between the producer and the engine, gas will escape. As has already been mentioned, this gas is very poisonous, and may cause the death of a careless operator. The suction producer is full proof in this respect, because the pressure in the system is less than atmospheric. If, then, there are any leaks in the system, all that can happen is that air will pass into the system through these leaks. While this will reduce the efficiency of the plant, it can do no other damage. The fact that no boiler or gas holder is required in the suction producer is a great point in its favour, because simplicity is the essence of good engineering, especially when we are dealing with a machine which is going to be put under the care of men who have no engineering knowledge or skill.

It takes only a few minutes to start up a small gas producer plant. The Highland and Agricultural Society of Scotland made some tests in Glasgow in 1905, to ascertain the time required to get an engine and producer plant to full working load, starting with the producer empty and cold. Only two men were allowed to start each plant on trial. The results were as follows:

Builder of Plant.	Capacity of Plant. B HP.	Time to start.	Remarks.
Campbell Gas Engine Co.	18	13 min.	
Campbell Gas Engine Co.	8	17½ min.	
Crossley Bros	24	15½ min.	
Industrial Engineering Co.	10	.. min.	Started but was compelled to stop because water was shut off at main.
National Gas Engine Co.	20	48 min	Excessive time caused by defective igniter.
National Gas Engine Co.	10	15¾ min.	
Messrs. Tangyres Ltd...	21	16 min.	
Messrs. Tangyres, Ltd...	12	12½ min.	

These tests were all made starting with the producer cold. The average value for a small plant is about 25 minutes. But in actual practice the fire is banked up when the producer is not in operation, as, for instance, when it stands over night. When this is done the engine can be running in about seven minutes from the start. According to Mr. J. Emerson Dowson, the stand-by losses due to this banking up of the fire amount, in a moderate-sized plant, to about three pounds of coal per hour.

Comparison of Steam and Producer Plants.

Dealing with efficiency, the adjoining diagram shows very clearly the values obtained from three characteristic plants.

Column 1 shows how the heat is used up in a modern steam plant of 250 H.P. The total heat contained in the coal was 952 B. T. U. Of this there is a loss in conversion of 20 per cent., much of the heat in the fuel passing up the chimney. There is a further loss of 10 per cent. in the feed pump, in condensation, and in radiation. Of the remaining 70 per cent, 57 per cent. is lost in the engine exhaust; and after making an allowance for friction losses, we find that out of a total of 100 per cent., only 10 per cent. is converted into actual work.

While this value of 10 per cent. may be obtained in test, in actual everyday practice the efficiency will be still less.

Column 2 shows how the heat is used up in a pressure producer plant of 250 H.P. There is, first of all, a loss of 25½ per cent. in radiation, in ashes, in gas coolers, and in steam boiler. Of the 74½ per cent. which goes forward to the engine, 33.2 per cent. is lost in cooling the engine cylinder, 20 per cent. is lost in exhaust, and after allowing for friction we find that 18 per cent. of the available heat is given as actual work in this system.

Column 3 shows the distribution of the losses in a 40 H.P. suction producer system. It may be taken for granted that the losses in a 250 H.P. system will be smaller. Of the total heat in the coal 89 per cent. is transferred in the gas to the engine cylinder. After deducting engine losses, as in the last case, we find that 23 per cent. of the available heat is transferred into mechanical work. The efficiencies then are as follows:

Steam, 10 per cent.; pressure producer, 18 per cent.; suction producer plant, 23 per cent.

There are one or two other points worthy of mention while dealing with the efficiency question. In a small steam plant the loss due to bad stoking is often quite considerable; in a producer plant there is very little such loss.

The following are the combined chemical and heat equations of the reactions that take place in the gas producer:—

$C + H_2O = H_2 + CO$

$1 + \frac{18}{12} = \frac{2}{18} + \frac{28}{18}$ (1) or 1 lb. C + 1.5 lbs. H_2O = .166 lb. H_2 + 2.33 lbs. CO. Now, to separate 1.5 lbs of water into H_2 and O at the same temperature requires 11,500 B.T.U., and 1 lb. C burned to CO gives 4,400 B.T.U.; therefore, to turn 1.5 lbs. to water gas requires other 7,100 B.T.U., or the burning of $\frac{7\cdot100}{4{,}400}$ = 1.61 lbs. of C to CO, according to the equation.

(2) 1·61 lb. C + 2.15 lbs. O = 3.76 lbs. CO + 7,100 B.T.U.; therefore, finally, by adding together equations 1 and 2 we get 2 61 lbs. C + 2.15 lbs. O + 1.5 lbs. steam = .166 lb. H + 6.09 lbs. CO. Now, the heat in a lb. H = 69,000 B.T.U.;

therefore .166 lb. H_2 = 11,400 B.T.U.

also, 6.09 lbs. CO. = 26,400 B.T.U.

or 2.61 lbs. C give a gas with 37,800 B.T.U.

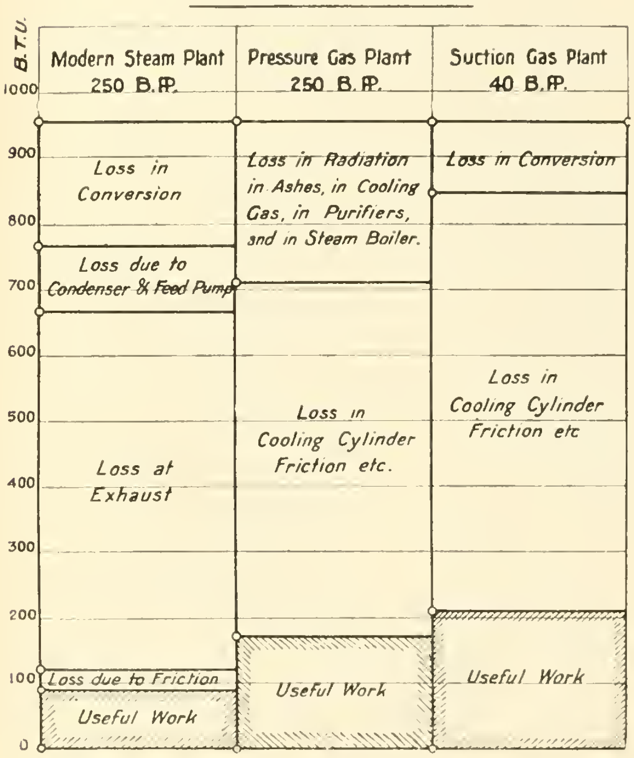
1 lb. O gives a gas with 14,500 B.T.U. = the calorific value of the fuel. Again, 1 lb. H_2 occupies 180 cu. ft., so .166 lb. H occupies 29 cu. ft. 1 lb. CO occupies 186 cu. ft., so 6.09 lbs. CO occupies 77.8 cu. ft. or the gas from 1 lb. carbon occupies 106.8 cu. ft. and has 14,500 B.T.U.; therefore, the calorific value of our producer gas is 136 B.T.U per cu. ft. In practice, 12.5 lbs. coal give 1,000 B T.U., and, with coal at $6 per ton, 1,000 cu. ft. gas costs 1.74 cents. Lighting gas from the city mains costs about 60 cents per 1,000 cu. ft., and its calorific value is only four times as high as that of producer gas.

With regard to stand-by losses, as before mentioned, these are about three pounds of coal per hour in a moderate-sized producer plant, whereas, according to results obtained by Mr. Dowson, this loss is about 71.5 pounds of coal per hour in a steam plant of the same size. When we consider that most plants are idle for about 99 hours every week, we see how great will be the difference in coal bill due to stand-by loss.

This loss is small in producer plants because, since very little air is passing through the fire, when the fire is banked up in the gas generator that piece of apparatus is turned into slow combustion furnace.

With regard to the efficiencies mentioned on the last page, there is a point of great practical interest which is too often overlooked. When we say that the efficiency of a steam plant is 10 per cent., while that of a gas producer plant is 23 per cent., we mean,

DIAGRAM SHOWING
HOW THE HEAT IN 1 LB. OF COAL IS UTILIZED
IN THREE CHARACTERISTIC PLANTS.



among other things, that, for the work equivalent to 10 tons of coal, we must not only buy 100 tons, but we must also pay for the labor of handling this, and also for storage space. With the producer plant the calculations are made only on 23 tons of coal. A similar relation holds in the disposal of the ashes.

Dealing now with the problem of fluctuating loads, the following test was made on a suction producer plant by Messrs. Crompton & Company, Limited, of London, England. A gas engine was run for four hours with a load of 10 H.P., then a load of 80 H.P. was thrown on suddenly. The plant immediately responded, and hardly a flicker was noticed in the lights supplied from this engine. It is to be borne in mind also that this was done without the use of a gas holder. This can be done by any well-designed producer plant, and is a performance that an engine working from a steam boiler would find very hard to beat.

Coming now to the problem of attendance. It is found that a complete producer and gas engine of 100 B. H.P. capacity requires the labor of one man for two hours each day, to keep it in first-class running condition. Everyone who has run a steam boiler and engine plant knows the troubles that are constantly turning up. The sanitary authorities complain that so much smoke is being thrown into the air, or the injector fails to operate, and the water begins to creep down in the water gauge. The boiler has to be cleaned out twice a year; there is a large amount to be paid for insurance, for inspection, for wear and tear of fire bars and other fittings, for the repair of leaks in joints caused by the high pressure of the whole system, and, finally, there is the knowledge that some day the whole plant may take it into its head to go out by the roof.

Contrast with this the gas producer. It is clean and efficient, there is very little water to handle (three-quarters of a gallon per B. H.P., a steam plant requires four gallons per B. H.P.), and very little attention required. The whole system, except the engine is subject to pressures of only a few pounds per square inch. There is no chimney to build and maintain, nor is there any smoke nuisance. When the facts are considered that the system is cheap to instal, and also cheap to operate, one has to wonder at the slow growth of the gas producer industry compared with what it might be.

It has been argued against the producer plant that gas engines are not very good for the operation of electric generators. As an example to contradict this statement, in Grenada, Spain, three single cylinder gas engines were installed, rated at 80 B. H.P. each. These engines drive alternators in parallel, and have supplied the whole city with light for the last two years. Now, there are gas engines on the market in which the problem of balancing has been very carefully dealt with. If the result mentioned above could be obtained with single cylinder engines, there should be no difficulty in obtaining satisfactory operation from the modern three cylinder engines.

The following is taken from Dr. Oskar Nagel:

Several years of experience have shown that the gas power plants are fully as reliable as the best steam plants, and have the advantage of much greater economy. The following table of results of plants built in Austria and Germany, on the Koerting system, bears out his statement. It is to be noted, with regard to these results, that the plants are small, and were working only a short time each day, and that stand-by losses are taken into account.

Place.	K. W. hrs.	K. W. per lb. coal.	Lubric. oil per K. W hour.	Cotton. watts per K. W. hour.	H. P. Capacity.
Clausthal	219,150	.36	5.6	.558	100
Cransee	51,847	.36	5.62	.558	100
Neumarkt..	125,076	.37	7.22	.442	80
Neurode	119,800	.24	3.03	1.42	160
Reichenbach	49,437	.3	6.20	.50	60
Soberheim	95,326	.36	7.36	3.50	100
Schoenberg	58,514	.35	12.8	1.30	80
Schwetz	82,312	.398	4.81	1.06	160
Walserorde	60,352	.32	8.24	2.03	70
Wienenden	71,828	.24	6.97	1.98	160
Karlsrube	70,766	.45	5.14	1.08	100
Werden	102,716	.36	6.07	2.99	90

A few facts and figures at this point should prove of interest.

A small joiner shop was driven by a 30 H.P. motor. This motor was replaced by a 60 H.P. suction producer plant, built by the National Gas Engine Com-

pany. The electric drive cost $13.20 per week. The same work was done by the producer at $2.88 per week for fuel, $5.32 for labor, oil, etc., also interest on capital and depreciation. This shows a net saving of $6 per week. It also shows that the gas engine is going to be a keen competitor of the central station (electric).

The National Gas Engine Company installed two complete suction plants in the south of Scotland, in a factory which had been buying power from a central station. Before the installation was made the engineers in charge of the work made the following calculation of probable saving: The 160,000 units of electricity required per annum, at 3⅛ cents per unity, gives a power bill of $5,000 per annum. For the same power, with a suction producer, assuming one pound coal gives one B. H.P. hr., 108 tons of coal per annum would be required. At $3 per ton the fuel for the producer costs $324 per annum. Allowing 10 per cent. for interest on capital and depreciation, $471 for labor, $120 for oil and sundries, the total expenditure is $1,881 per annum. The cost of engine and producer plant, complete, was $6,240, the electrical equipment cost $3,360 for two dynamos, switchboard, and wiring, or the total cost of $9,660. A saving of $3,119 per annum would therefore pay for the whole plant in three years.

It is interesting to mark the effect of the perfecting of the gas producer on the gas engine industry. Messrs. Thorneycroft & Company, shipbuilders, London, England, have just fitted a number of canal barges with suction producer plants and gas engines. The results of these have been so satisfactory that they are going to try them on coasting and merchant vessels. The British Admiralty is making experiments to find what are the limitations in using it for naval work.

The greatest advantage the producer has for marine work is that the amount of coal to be carried is greatly reduced.

In a country like Canada, where farming is done on a large scale, and where the power users are so scattered as to prohibit the building of central stations for power and light, the gas producer ought to have a large and increasing use. Messrs. Tangye, Limited, of Birmingham, England, have put on the market a portable gas engine and producer plant, to meet the demand of the farmers.

About ten years ago attention was drawn to the fact that a large amount of power is available in gas which is usually thrown away from blast furnaces. It had been stated on good authority that 468 H.P. may be developed per ton of iron produced per hour. In the United States of America alone there were produced in 1905 23,000,000 tons of pig iron. This is equivalent to an available power of 1,225,000 H.P.

The chief difficulty to be overcome in the use of this blast furnace gas in a gas engine is that connected with the removal of the large quantities of dust which it contains. Another difficulty sometimes met in a small plant, namely, that the gas is very variable in quality, is overcome in large plants by mixing the gas obtained from several furnaces together. However, the trouble due to this is not very great in a well-designed plant. The gas, which is very hot when it leaves the furnace, is usually cooled in the process of extracting the dust.

The quantity of dust in the gas varies greatly with the kind of ore and coal used. For instance, the Cockerill Company, Belgium, had a 200 H.P. gas engine running at their works in Seraing for three years, without any special provision being made for the elimination of the dust contained in the gas. During all that time the engine never had to be cleaned on account of dust, although it was running night and day.

On the other hand, this same company, at their works in Differdingen, experienced trouble right from the start with some 600 H.P. engines which they installed. Investigation showed that the Differdingen gas contained four to five grammes of dust per cubic metre of gas, while the Seraing gas contained only from .25 gm. to .5 gm.

Experience shows that furnaces using hematite ores give a gas containing very little dust, and what dust there is settles easily, even in short lengths of pipe. Oollitic ores, on the other hand, give a gas containing much dust, which passes quite readily with the gas through long lengths of pipe.

There are two ways at present in use for the purification of blast furnace gases.

1. Passing the gas through scrubbers containing sawdust or coke is exactly the same way as in done with producer gas.

2. The gas is caused to pass through a centrifugal fan. A jet of water enters the axis of the fan, and is driven outwards in the form of a fine spray. This spray of water gathers up all the dust in the gas. This latter method was tried in the Differdingen plant, already mentioned, with the result that while the gas contained 4gms. dust per cubic metre when it left the furnace, it held only .25 gm. after passing through the fan, and could then be used with success in the engines.

The calorific value of this gas, as might be expected, is very variable. It may be taken that rich gas means poor operation in the blast furnace, while poor gas represents good operation therein. The average analysis shows CO, 28 per cent.; H, 2.5 per cent.; CO_2, 7.25 per cent.; N. 61.3 per cent.

This paper has been an endeavor to point out a few of the merits of the gas producer. The subject can only be taken up in a general way, because there are so many conditions to be met in the problem of power generation, that each case must be taken separately; nevertheless, the success of the producer, during the few years in which it has been developed, makes a thorough knowledge of this piece of apparatus necessary to anyone who pretends to be up to date in power plant work. The small producer plant has a field in sparsely-settled districts which cannot be as well met by any other existing piece of apparatus. The blast furnace engines are also growing in popularity as their operation becomes better known. As has already been pointed out, there is a great deal of power going to waste at present in existing blast furnaces. If the whole of the power from Niagara was utilized, it would only give three times the H.P. that is thrown away by the blast furnaces of the United States of America alone. From these facts one is encouraged to believe that the gas engine industry has a bright future before it, now that the gas producer has proved to be a commercial success.

Water Wheel Governors

There is considerably more to the speed controlling mechanism of a turbine than may be correctly included under the term "governor." There is first the speedgate, an adjustable opening or series of openings admitting water to the running wheel, the form of which depends upon the type of water wheel to which it is to be applied.

As far as efficiency is concerned, it is seldom that the 85 per cent attainable with the old, slow-moving overshot wheel is surpassed, a more usual efficiency for the best modern wheels being 80 per cent. But the size and speed of the overshot wheel render it unsuited for modern requirements, where the main demand is for high speed wheels to drive electric generators. For this purpose only two types of water wheel are now in general use, the inward flow, downward discharge turbine, commonly known as a Francis turbine, and the tangential or impulse wheel in which the water is projected on to the buckets in ore or several jets of small section. The Francis turbine may be built for heads up to 300 to 400 feet, while the tangential wheel is suited for heads of about 50 to 1,000 feet and over.

Whatever type is used the speed gate should be so constructed as to keep the direction of the jet as constant as possible at all loads, for the wheel buckets may be quickly worn if the jet strikes them at a wrong angle. It is necessary for a high efficiency that changes of guide section should be made as gradually as possible. A rectangular nozzle with a hinged tongue, or a conical nozzle with a central spindle (known as a "needle nozzle") make good speed gates for the tangential wheel, while the Francis wheel is best supplied with a wicket gate, the guide blades turning, and thus acting as gates as well as guides. It is true that a wicket gate is more easily clogged than the more simple cylinder gates, but its efficiency is higher.

Too much should not be expected of the turbine builder. It is, for example, impossible to make a turbine which will not wear out within a short time if there is much sand in the water, nor can a turbine be designed which will not get clogged if a large amount of rubbish is allowed to flow into it. Leaves or ice may stop a wheel, and when the water is low, eels may produce the same effect. Thus, if sand can not be removed from the water, there is no remedy but to replace turbine wheels when worn out, and if much extraneous matter must flow through the wheel, it is better to have a cylinder gate than a wicket gate and to sacrifice efficiency for the sake of certainty of operation.

Between governing a water wheel and an engine the great difference is that in the latter the power required to change the point of cut-off is comparatively small, while in the former the power required to move the heavy speed gate may be as great as that of the turbine itself owing to the inertia of the working fluid.

It is therefore rarely possible with a turbine to effect the regulation directly by the force of the flyballs or other force depending directly upon the speed. The flyballs must set in operation a force great enough to move the speed gate. Various kinds of purely mechanical arrangements have been tried, but the "hydraulic" relay has proved to be the most sensitive and satisfactory. The flyball governor merely operates a valve which admits a fluid under pressure to the relay cylinder, in which there is a piston connected with the speed gate. It will be seen that the governor may be made very light and sensitive, since the power required of it is very small. Either water or oil may be used as fluid in the governor cylinder and valve chest. If a sufficient supply of pure water under pressure is at hand, that will prove the more convenient, though it will almost always be necessary to provide a filter for even the purest water, such a filter being so designed that it may be cleaned during operation. If oil is used, the pressure must, of course, be produced artificially, but the oil pressure relay has the advantage that it will not freeze.

"Hunting" or "racing" is the greatest trouble with sensitive governors. It is an oscillation on each side of the proper position, caused by over-regulation. This may be remedied by arranging the governing mechanism so that any movement to their side of a predetermined middle position will set up a force in opposition to this movement, thus tending to bring the whole mechanism more quickly back to the normal position.

There is another detail of a turbine, which, while not actually a part of the governing apparatus, yet depends upon it. The rise of pressure in the penstock bringing water to the turbine when the speed gate is shut will depend upon the quickness of action of the governor. The better the governor, the more necessary does it become to supply a relief valve, opened by the governor at the same instant that it closes the speed gates, and which then gradually and automatically closes. Of course this does not take the place of a standpipe to prevent too great a reduction in pressure when the speed gate is suddenly opened.

Coming now to the results which may be expected in the way of speed regulation, it should be born in mind that the speed variation caused by a sudden change of load will depend upon the weight of the revolving parts as well as upon the governor. But it may be said that an average readily attainable result is holding the change of speed due to a sudden change of load, from no load to full load down to 10 per cent., in addition to 4 per cent. due to a gradual change of load. Better results than this have been attained in special cases, as, for example, the noteworthy tests of hydraulic governor made by the Niagara Falls Power Company in May, 1901, where the change of speed due to a sudden variation of load of 100 per cent. was only 3.8 per cent.

At the same time a most interesting comparison was made between the mechanical governors then in use and the new hydraulic governor. Five turbines, each supplied with a mechanical governor, were electrically connected in parallel, and it was found that when a sixth turbine, controlled by a hydraulic governor, was added, the speed variations were reduced to only about one-third of what they had been before. In other words, the one hydraulic governor

threw the five mechanical governors out of action, and alone governed the six turbines.

Be it not understood from this specific case that no good mechanical water wheel governors exist. There are governors in which centrifugal displacement of weights ingeniously transmitted to the gate by effect-multiplying mechanism does efficiently control turbines of the inward, downward and outward flow type, but it is only recently that they have been brought to high efficiency.

In general it may be said that governing accurately without sacrificing a large amount of water is difficult, and that efficiency of regulation requires an exact adaptation of means to the special case in hand. For instance a small alteration in length or diameter of the supply pipe has been known to completely destroy the accuracy of a governor which had been perfectly reliable before the change; and it is well established that with impulse wheels the kinetic energy, hence the speed, increases up to a certain point as the gate is closed from full opening and conversely decreases as the gate is opened wider.—Electrical Record.

CARE OF SPARK COILS.

Ignition mechanism at best is of delicate construction and requires considerable attention. Of the mechanism the spark coil is an important part, and one of the first considerations it should receive is to keep this coil in a dry place. This does not necessarily mean to keep the coils where they will get hot, but where they do not get damp. As the pressure of the jump spark is so high that the current will run along a little streak of moisture almost as well as on a wire, and though it tends to dry up the moisture in so doing, it sometimes carbonizes the wood, and, as wood is a conductor when blackened by heat, another path is made for the current. On launches, especially, too much care cannot be taken to have a good place for the coil and bath battery.

When using a series of dry batteries, do not use over 6 dry cells, or 3 cells of storage batteries. If the coil does not work with this number of cells in good condition, there is something wrong, and increasing the size of the battery would only burn out the contact points, without helping the secondary spark materially.

There is a tendency among gas engine operators to set the vibrator spring too tight, so as to get a good, big spark. When the spark is tested in air at atmospheric pressure, it will seem big enough to fire almost anything, but as a matter of fact it will skip and bother on a quick moving engine. What is wanted for successful running is a quick and sure spark that will get there just when it is needed and every time. This kind of a spark is usually a small one, and the adjustment to secure it is given in the following by E. Q. Williams, in the Scientific American:

Draw back the vibrator screw until it does not touch the spring, then set the spring so that the iron head is from 1-16 to 1-8 inch from the core. Bring the screw up until it touches the spring lightly and start the engine. If it skips any try adjusting the screw a little tighter, but leave the spring just as weak as possible and not have the engine skip. In this way the engine will run at its highest speed, and the batteries will last much longer. The current can be frequently increased to three or four times the amount a coil should take by merely setting the spring stiff and getting a big spark. On the other hand, there is danger of getting it too weak, so that when the engine stops the vibrator spring will not touch the contact screw and the engine will not start.

Sometimes the wire becomes broken inside the insulation and may give considerable trouble in locating it. Usually the wires break where they are moved or bent most, as at the commutator, or where there is a great deal of vibration. The broken place can be located by bending and pulling, as the wire will be very much weaker and more limber in the broken spot. Some operators take another piece of wire and jump the affected wire. In this way the break can soon be found and the defective wire replaced or repaired.

To reduce the number of wires to the engine, spark coils usually have one terminal of the secondary grounded, and when the coil ceases to spark or breaks down, it frequently happens that by changing this ground to the other secondary terminal and putting the plug wire on the terminal that was grounded the coil will work as well as ever and run for a long time.

See that the secondary or plug wires do not come in contact with a hot pipe or cylinder, for if they do, or if they are even near enough to become hot, they are sure to give trouble sooner or later. When the wire is too near the cylinder, block it up with a piece of wood or fibre, or, if possible, move it away entirely, also keep oil away from the wiring, as oil rots rubber, which is the insulation used to guard against dampness.

Do not draw the spark out in the air to see how long it is. This strains the coil, and if there is any weakness it will be sure to increase the trouble, even though the coil may not break down altogether.

It is a good plan to watch the spark plug, as well as the spark points, as many a coil is blamed on account of the plug. Frequently the outside gets greasy and dirty enough to cause the plug to miss a spark, or, if the plugs are foul, the spark cannot ignite. It is thus advisable, if the operator desires solid enjoyment from the ignition system, to keep everything clean and dry.

CANADA ELECTRIC COMPANY'S IMPROVEMENTS.

The rapid growth of the Town of Amherst and increased demand for electric light and power have made it necessary that the Canada Electric Company should increase their plant. The company has recently placed an order for a 200 horsepower Robb-Mumford boiler and 225 horse-power Robb-Armstrong Corliss engine, for operating two 75 kilowatt Canadian General Electric Company generators. As soon as the increased plant is installed the company will operate a day service to meet the growing demand.

The Board of Control of the City of Winnipeg have obtained figures showing the cost of the power used monthly for operating the waterworks and the street lighting system. In the month of December last the cost was as follows: Street lighting, $4,085.85; lighting city buildings, $685.20; day lighting from Winnipeg Electric Railway, $71.57; total for month, $4,842.62. The cost of electric current for the waterworks was $2,759.98. The City Engineer has informed the Board of Contral that in addition to the above the electric current for operating the new wells now being built, if generated by steam, will cost approximately $8,000 per month.

Effect of Armature Reaction in Synchronous Motors and Rotary Converters.*

By Mr. B. T. McCormick.

As a rule in treating the operation of synchronous motors and rotary converters, the diagrams are constructed without reference to the effect of armature reaction. The complete diagram of the rotary converter or synchronous motor depends upon the following laws:

1st—The vectorial sum of the generator or impressed E.M.F. E_g and the motor counter E.M.F. E_m is the reactance E.M.F. E_x.

2nd—The counter E.M.F. must be represented as lagging 90° behind the resultant field or magneto motive force.

3rd—The armature M.M.F. is in phase with the armature current.

4th—The E.M.F. component necessary to balance the reactance E.M.F. is equal and opposite to it in phase, and must, therefore, be represented as leading the current in quadrature.

5th—The resultant M.M.F., or that M.M.F. which when divided by the reluctance of the magnetic circuit gives the flux per pole, is equal to the vectorial sum of the M.M.F., due to the armature reaction, and the M.M.F. impressed upon the fields, as obtained from the ammeter readings in the field circuit.

6th—The total armature reaction may be expressed in ampere turns per pole as .707 an $\frac{I}{2}$, where "a" equals conductors per phase per pole, "n" equals number of phases and "I" is the current per conductor. This applies to the form of winding usually employed in alternators. For rotary converter windings better results are obtained by calculating the armature reaction in direct current terms.

General Synchronous Motor Diagram.

The quantities involved in the general synchronous motor diagram are so numerous and so interdependent that one is at a loss, when starting to construct the diagram, to decide what quantities to assume as fixed. We can always assume a constant source of E.M.F. E_g, and if we assume the load the motor is carrying and its losses, we immediately have the watt component of the current.

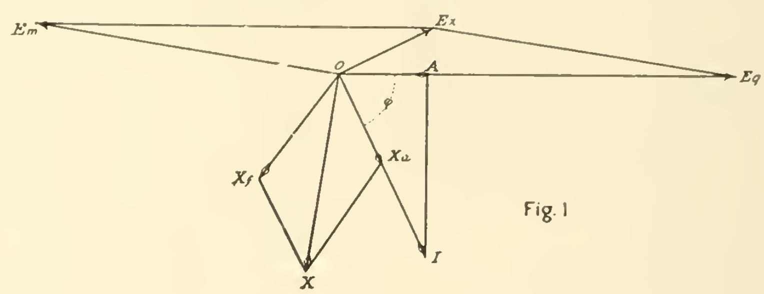


Fig. 1

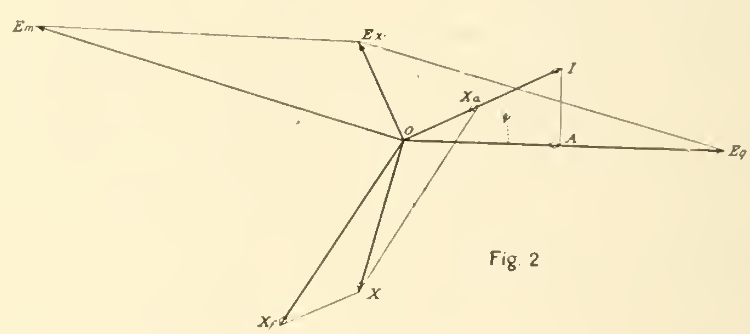


Fig. 2

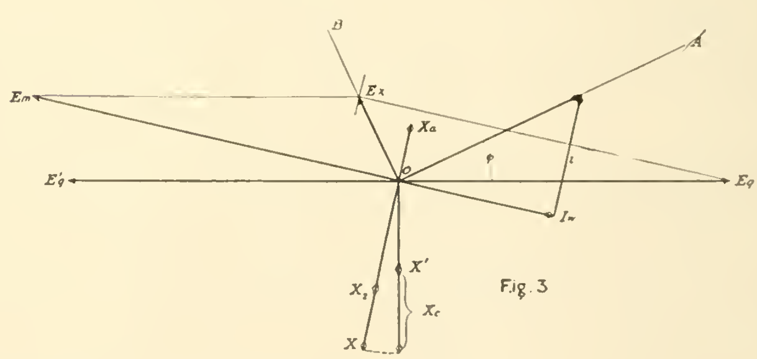


Fig. 3

It is a fact well known to all switchboard operators that with the given load on the synchronous motor, the power factor may be varied over a certain range by altering the field excitation of the motor. We have to start with, therefore, the impressed generator E.M.F. E_g the total current and power factor. Lay off E_g equal to the generator E.M.F. to any desired scale, also the watt component of current O.A. Lay off the total current O.I. making the angle between it and $E_g = \phi$ whose cosine is equal to the power factor which we have assumed. (See Figure No. 1.) At right angles and leading the current 90, lay off E_x, the reactance voltage which is the product of total current

*Paper read before the Montreal Electrical Section of the Canadian Society of Civil Engineers, by Mr. B. T. McCormick, electrical engineer for Allis-Chalmers-Bullock, Limited, Montreal.

and total reactance in the circuit, the resistance being small in most cases is negligible. Combining E_g and E_x gives E_m, the counter E.M.F. of the motor. Lay off X_a in phase with the current, representing the armature reaction to any desired scale. Lay off X, leading the counter E.M.F. 90° representing the excitation required to produce the counter E.M.F. on open circuit, as read from the no load saturation curve of the synchronous motor. Since the resultant ampere turns X is the vectorial sum of the field and armature ampere turns, the field ampere turns are obtained by subtracting vectorially X_a from X, this gives X_f, the field excitation necessary for the motor to operate therefore, be stated as a general principle that with a lagging current on the synchronous motor the effect of the armature reaction is to strengthen the field, and in that way decrease the necessary field excitation.

Figure No. 2 shows the synchronous motor operating with the leading current, and it will be noted that the conditions are just the reverse of those shown in Figure No. 1. Here the reactance volts E_x adds to the generator volts E_g, producing a larger value of counter E.M.F. E_m, while the armature reaction, when subtracted from the resultant field, leaves an impressed field ampere turns greater than the required resultant field. It may, therefore, be stated as a

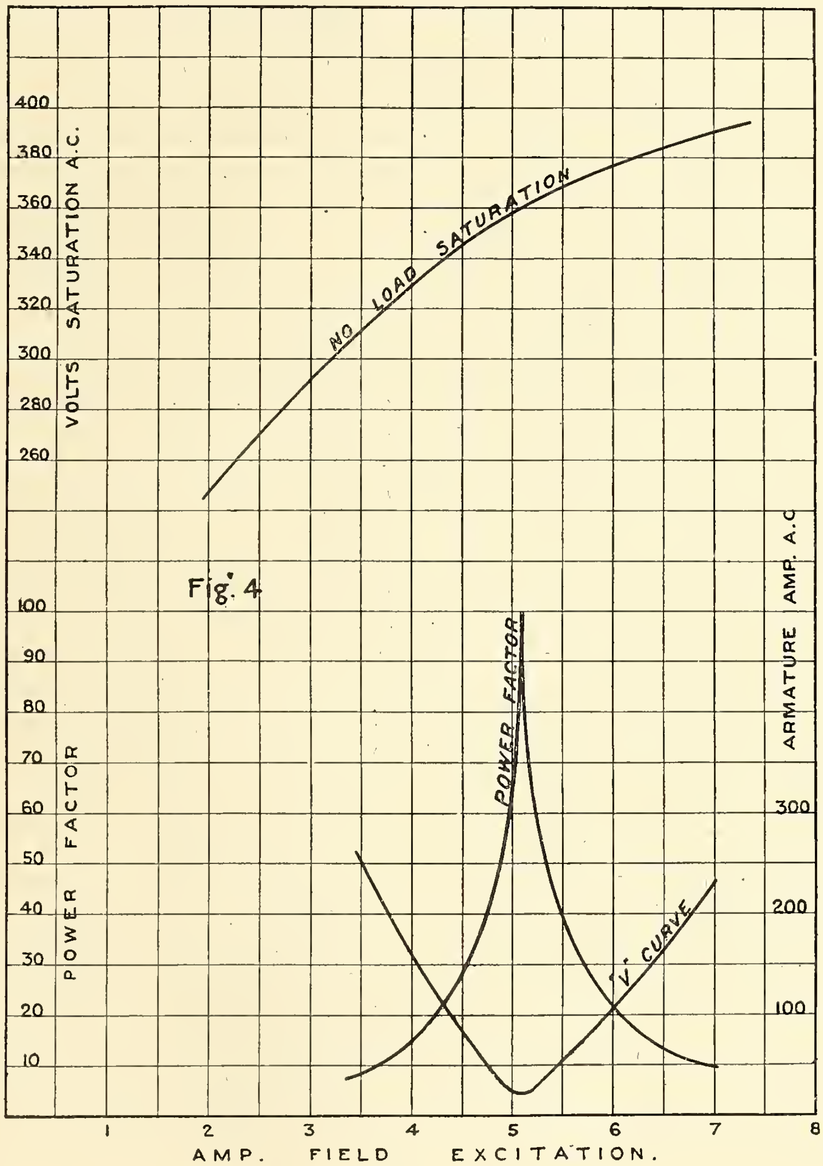


Fig. 4.

under the assumed conditions. The above diagram for any load on the motor gives us the value of field excitation required for the assumed value of power factor. The various values of power factor may be assumed and diagrams constructed, and the results plotted into a curve between field excitation and total current, or field excitation and power factor.

Figure No. 1 shows the diagram for a lagging current, and it will be noticed that the reactance voltage is in such a phase position as to subtract from the generator voltage, resulting in a smaller value of the necessary counter E.M.F. The armature reaction X_a is in such a position that, when subtracted from the resultant ampere turns X, the field ampere turns are smaller than the resultant ampere turns. It may, general principle that when a synchronous motor is operated on leading current, the armature reaction tends to weaken the field, thus increasing the necessary excitation in order to produce the required resultant magneto motive force.

Rotary Converters.

In a rotary converter the current in the windings may be considered as made up of two components, the alternating current flowing into the rotary converter from the line and the direct current flowing out at the commutator. The alternating current is of two components, one a wattless component with respect to the counter E.M.F., and the other a component in phase with the counter E.M.F. of the rotary. It is only that component of alternating current which is in phase with the

counter E.M.F. which is converted into direct current. It may, therefore, be said that the power component of alternating current and the direct current, since they flow in opposite directions, neutralize each other, thus producing no armature reaction, and the armature reaction of the rotary can be, with a fair degree of accuracy, assumed to be produced only by the wattless component of alternating current.

The diagrams of the synchronous motor are applicable to the rotary converter with the above change of armature reaction. The construction of the rotary converter diagram will be made clear by the following example: (See figure No. 3.) Given a rotary converter operating on no load, to find the reactance necessary for a given compounding at a given power factor of input. At no load the impressed E.M.F. E_m and counter E.M.F. E_g are very nearly equal. Lay off O.A., and extend indefinitely, making angle p the angle corresponding to the required power factor. Lay off O.B. 90° ahead of O.A., and extend indefinitely. With E_g as a centre, and required counter E.M.F. E_m (voltage corresponding to D.C. voltage), as radius, strike an arc which locates point E. E_x then equals reactance volts. Complete the parallelogram E_m O E_g E_x. Lay off I_w in opposition phase to E_m and equal to the current corresponding to D.C. output. Erect a line at I_w perpendicular to OI_w. This gives i, the current which is wattless with respect to counter E.M.F., and the only current producing appreciable armature reaction. X_a equals this armature reaction and OX_2 equals field ampere turns necessary to give E_m on no load, as read from the no load saturation curve. Add X_a and X_2, which gives OX, the resultant excitation necessary. X′ equals excitation necessary to produce no load voltage, $-E_g'$. Subtracting X′ from X leaves X_c, the necessary compound ampere turns. This last subtraction must be performed algebraically, and not vectorially. As soon as I and E_x are known, the reactance which must be inserted in the line can be calculated. The above diagram may be constructed by using either alternating current or direct current quantities, but whichever quantities are chosen must be used throughout the diagram. The alternating voltages can be reduced to direct current voltages by dividing by .612, while alternating current amperes can be reduced to direct current amperes by multiplying by 1.06.

Figure No. 4 shows the application of the foregoing methods to the determination of the "V" curve of the synchronous motor. The motor has six poles, with 2,500 field turns per pole, and 324 armature coils of one turn each. The "V" curve was taken with a reactance of .0416 ohms in each leg, and the A.C. voltage was kept constant at 360 volts. As the curve was taken at no load, the power factor is so low in all cases that it is not necessary to lay out the diagram, as all vectors with which we have to deal will lie so nearly in phase with those with which they add or subtract that the operations can be performed algebraically instead of vectorially. All the values will be considered in A.C. terms. We will first take the 200 ampere point for leading current—the reactance voltage $E_x = 200 \times .0416\sqrt{3} = 14.35$, the factor $\sqrt{3}$ being used to change reactance volts from volts per leg to volts across lines. With the leading current reactance volts will add directly to the generator E.M.F. This gives $E_g = 360 \times 14.35 = 374.35$, which corresponds on the no load saturation curve to 5.9 field amperes. Since the rotary converter, when considered from the standpoint of a D.C machine, is a six circuit winding, the current per conductor in D.C. terms would be 200×1.06 divided by 6. This, when multiplied by the total number of turns, 324, and divided by the number of poles, will give the ampere turns armature reaction per pole.

$X_a = \frac{200 \times 1.06 \times 324}{6 \times 6 \times 2500} = .76$ amps. expressed in terms of field amperes, in which the 2,500 appears in the denominator to reduce to field amperes. This armature reaction will weaken the field, and require an excitation of 5.9 plus $.76 = 6.66$ amperes.

Checking the above for lagging current $E_m = 360$ minus $14.35 = 345.65$. This corresponds to no load excitation of 4.5 amps. X_a as before equals .76 and X, 3.74 amperes. As it will be seen, the two above points coincide very closely with the curve which represents values actually observed on test.

LACKING IN EFFICIENCY.

London, Eng., has two telephone systems. One is owned, controlled and operated by the Post Office Department. The other belongs to the National Telephone Company. The rates charged by both systems are identical, and, moreover, the systems are interchangeable, that is, it does not cost a Post Office subscriber any more to call up a National subscriber than it does for a connection with another Post Office subscriber. The competition between the two systems is confined merely to efficiency of service. On the 31st December, 1902, the end of the first year of competition, the National had in their London system 40,759 more stations than the Post Office system. At the end of last year the National Company had 44,000 more stations than the Post Office, an increase during five years of 3,241 stations. Yet there were those who prophesied when the Post Office decided to go into the telephone business that it meant the ruination of the National Company.

The lesson is plain. The Government managed undertaking cannot compete on even terms with the privately-owned and managed concern. The job of the Government employer does not depend upon the attainment of results; that of the private company does. The consequence is that he is up and doing while the Government employee is counting the hours to the next pay-day. There are but few services in which efficiency is as important as in the telephone service. Everywhere it has been tried Government management is marked by a standard of efficiency lower than would be tolerated by a private concern.—Montreal Gazette.

PAINT FOR SWITCHBOARDS.

The Western Electrician gives the following answer to an enquiry for some non-conductive black enamel or compound suitable to paint an old 110-volt slate switchboard:

"Any hydro-carbon paint which has the right consistency to give a good surface should be satisfactory for this purpose. In other words, a paint which has the proper 'body' and which will 'run' fairly well when applied on the cold slate should be sought. An ordinary air-drying black japan is frequently used for this purpose. Insulating paints are to be had from the manufacturers and from dealers in electrical supplies."

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Can you tell me how the current is fed into the cars in New York City, on the underground, surface, and elevated railways, and what system of control and braking is used?

Answer.—The systems used in the subway and the overhead lines in New York are identical. An insulated third rail is mounted adjacent to the tracks, and the current is collected from this rail by means of shoe contacts, passed through the motors and delivered to the track, which acts, of course, as the return circuit. In the five or six car train, which is a standard length, there are usually three motor cars, each carrying a four-motor equipment. Trains are made up of, first a motor car, and then a car without motors, and so on throughout the entire train. When an even number of cars are used, it is also customary to make the last car a motor car. Each car which carries a motor is equipped with an electrically operated controller, which in turn is operated by the master controller located in the first car. There is a master controller in every power car, but, with the "multiple unit" system of control, the entire train can be controlled from any point. Air brakes are, of course, used on every car, the power cars carrying a motor-driven compressor to supply the necessary air. The brakes are extremely powerful, and it is possible, therefore, to bring a heavy train to a dead stop within a very short distance. The distribution of motor cars in a train also makes a high rate of acceleration possible, and to the combination of these two features is due the remarkably quick service which is obtained in New York, that is to say, very little time is taken for the stopping and starting of trains. On the surface roads, the old cable systems have been done away with entirely, and the standard electric cars have replaced them. The overhead trolley is, of course, prohibited, and hence the conduit system has been adopted. The conduit is practically the old cable slots, with necessary modifications for an electrical system. A "plough" is carried on the bottom of each car, and runs through the slot in the surface down into the conduit. The plough carries two shoes, which make contact with two insulated tee rails, one rail being the positive and the other the negative. In this way a complete metallic circuit is provided, and the tracks and earth are not used as conductors. This, of course, gives a system that will not produce electrolytic damage, which, as is well known, is an extremely serious matter in New York City. The slot through which the plough runs is very narrow, and is deep enough to prevent any contact being made with either tee rail from the surface. This at one time was a decided drawback to the system, inasmuch as various persons, either through malice, or for some other reason, were in the habit of inserting narrow strips of iron down the slot and making contact with the tee rails, thus producing short circuits. The more modern construction, however, as stated above, makes this impossible. Considerable difficulty was experienced at first through water in the conduits, but improvements in the methods of mounting the tee rails, and the providing of good drainage, have practically done away with the trouble. Instances are on record where conduits have been completely flooded. This produced a leakage in Washington of some five hundred amperes on one section of road, but the line continued to run, nevertheless. The conduit system of construction is, of course, very expensive, but when propertly built gives excellent satisfaction, does away with electrolytic damage, and eliminates the use of overhead wires, which, in a big city, is naturally an important consideration. The electric surface cars in New York are using hand-power brakes, though quite recently air brakes have been adopted on some lines, cars are run in pairs, and the multiple-unit control has been incorporated. There are several lines in the city which continue to operate horse cars, but these are being rapidly replaced. Several experiments have been made with cars using compressed air, but the apparatus was discarded within a very short time as impracticable.

Question No. 2.—What is meant by the smashing point of an incandescent lamp?

Answer.—As incandescent lamps become old, there is a decided decrease in the efficiency, some cases being on record where very old lamps were found to consume somewhere in the neighborhood of fifteen watts per candle. When a condition such as this exists, the character of the light given by the lamp is decidedly unsatisfactory. Hence there will be a point in the life of any lamp where it is more economical to renew the lamp than to burn it longer, and this point has been called the smashing point. This will vary, of course, with the first cost of the lamps, the initial efficiency, the final efficiency, and the cost of current. Where the consumer buys his own lamps, he will invariably operate them for a considerable time after the smashing point has been reached, and the result is that the high current bills and the poor light make him dissatisfied with the service. Companies who supply electrical energy should be most careful to impress this fact upon their consumers, and should make every endeavor to get the consumer to discard the lamp as soon as it shows any sign of getting bad. It is difficult, of course, to convince the consumer that it is to his advantage to purchase a new lamp, and in almost all the large cities the electrical companies have adopted the policy of free lamps, which, in every instance that we know of, has worked with entire satisfaction. The electrical companies must not forget that they are supplying light to their consumers, and they should make every effort to see that the consumer gets the very best possible light. In this way the business of the supplying company will grow to a very marked extent, and they will be more than repaid for the expense incurred by adopting the free lamp policy. Several editorials have appeared in this paper within the last few years covering this subject, and we would refer our subscriber to them for further information.

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Poulsen.

Valdemar Poulsen, of Denmark, is at the present time standing before the scientific world with two remarkable inventions to his credit, namely, the telegraphone and a system of wireless telegraphy. A number of years have passed since the first paper on the telegraphone was presented before the American Institute of Electrical Engineers. Since that time, the inventor, and others associated with him, have been working upon the device, until now it has reached such a condition as to warrant its being placed upon the market, and a company for that purpose has been organized in the United States. The phonograph, up to the present time, has, of course, been a very successful reproducer of sounds, though it has been limited in a number of specific cases when called upon to record and reproduce vibrations having certain peculiarities. The phonograph, however, has one serious defect, and that is the unavoidable scraping sound, which, owing to the principle of the apparatus, is and must be inherent. With a diaphragm sufficiently sensitive to respond to vibrations of practically all kinds, it is not possible to produce a recording surface which is so smooth as not to reproduce vibrations other than those intended to be indented upon it. The wax record of to-day is, of course, perfection when comparison is made with the original product, but the scraping noise is there, and it cannot be eliminated. Poulsen's idea in the telegraphone is really very simple. In the ordinary telephone receiver, variations in magnetism produced by variations in current originating from the transmission, cause the diaphragm to vibrate in unison with the transmitter. Poulsen conceived the idea of substituting a moving wire or a revolving steel plate for the ordinary diaphragm in the telephone receiver, and hoped to be able to record, not the original vibrations, but the magnetism which represented these. In this he was particularly successful, though it may be noted that the principles used in his apparatus are contrary to all our known laws of magnetism. He has been able to confine or localize the magnetic condition, whereas all our own past experiments seem to show that there is no insulator capable of doing this. However, that he has succeeded is beyond all question. It is a well-known fact that if a coil of wire be moved through a magnetic field, a current will be produced in such coil depending upon the density of the magnetism. If the steel wire or plate upon which the magnetic impressions are localized be passed close to a coil of wire, current will therefore be produced in that coil practically of the same magnitude as that which recorded the magnetism in the first place, hence if a telephone receiver be placed in the circuit, the original sounds will be reproduced. As there is no contact between the transmitting magnet and the plate during recording, nor between the

receiving magnet and the plate during reproducing, it follows that the objectionable scratching sound of the phonograph will not appear. The one great field that we see for the telegraphone is its use in connection with telephone work. It makes possible the complete recording of a telephone message, and, like Gray's telautograph, which reproduces in the original writing of the sender, the record in the telegraphone is reproduced in the original voices of the speakers. So far as the field of the telegraphone is concerned, it will have other uses than the above. In fact, we may predict that if its cost is reasonable, it will probably supplant the phonograph, both in private and business use.

In his system of wireless telegraphy, Mr. Poulsen has accomplished two remarkable feats. First, he has increased the distance over which the apparatus may be operated, and, second, he has made it possible to transmit a number of messages within a given area without interference. It is also stated in connection with this invention, that it will make possible and practicable the use of wireless telephony, though as to this matter sufficient data has not been presented to enable a fair judgment. Mr. Poulsen uses, instead of the ordinary spark, an arc between carbons, which is maintained in carburetted hydrogen, and, it is claimed, by this device has been able to obtain vibrations exceeding one million per second. The use of this device has eliminated the distressing sound characteristic of almost all systems of wireless telegraphy, and has also enabled the transmission of a message over a given distance with a considerably lower mast, and a much lower consumption of energy. For instance, in one demonstration between Copenhagen and North Shields, which points are separated by a little over five hundred miles, communication was maintained with an expenditure of less than one kilowatt, and the masts used were less than one hundred feet in height. Mr. Poulsen, by what he calls his system of tuning, has almost made it possible to receive any number of messages at one station through the medium of one mast without interference, and also makes the important claim that the usual disturbances caused by atmospheric electricity are notably absent in connection with his work. Taken all in all, we would be inclined to think that Mr. Poulsen has given to the world of commerce, as well as the world of science, an invention which will prove to be of enormous value, and the credit which he will doubtless receive for this device, as well as for the telegraphone, will be only such as due a man who has carried original research into such new fields.

Wood in Hydraulic Construction.

The use of wood conduits in connection with hydraulic power houses is quite common in the Western States, and it seems peculiar that such method of construction has not been universally adopted. The wooden pipe is very easily constructed, and its life and low first cost certainly are points strongly in its favor. As is well known, the friction in a wooden penstock is considerably less than that in an iron pipe of equal diameter, and, where it is possible to keep the wood continually wet, the consensus of engineering opinion seems to indicate that the wood really has a longer life than iron or steel, and it is a fact worthy of note that the friction in the wooden line, though less than that of a corresponding steel or iron pipe upon installation, decreases with age, while, on the other hand, the friction in the iron pipe increases. Wood is now being advocated for use in ordinary waterworks construction, and its progress in this country will be watched with considerable interest. The inventors claim that its first cost is materially less, and that it has a longer life than an iron pipe, and serious consideration must be also given to the fact that a given diameter in the wood will have a greater carrying capacity than the iron.

Power Loads.

Many small municipalities in the Province of Ontario are considering the advisability of operating a day service and developing a power load. This is a matter which will require the most serious consideration on the part of the councillors, and many complications will be found therein which make the proposition anything but simple. In the first place, we would say that unless meters are universally installed, an attempt to operate a day service will result in financial loss. Flat rate towns are bad enough at the present time, even with a night service, because there are certain locations in which lights will be turned off simply for the convenience of the consumer, and the municipality may be fairly sure that those lights will be turned on again and burned the entire day if current be on the lines during this period. Where meters have been adopted, this, of course, will not be the case, and whatever lights are burned in the day time will be paid for in proportion to their consumption. The council must first consider the possible revenue from incandescent lighting, and must make a thorough canvass of all power users within the limits of the municipality. An estimate must then be made as to what proportion of these power users will become customers of the electrical plant, and consideration must also be given to the price which can be obtained per thousand watts or per horsepower per annum from such power users. By following this suggestion, the town will be able to arrive at the approximate revenue which can be obtained upon the inauguration of a day service, though we would warn the parties interested that they must be exceptionally conservative in making up such figures. Then comes the question of operating cost. The many items which go into such an estimate must be duly considered, and if the plant be steam-driven, a pretty accurate idea of the fuel consumption can be obtained from a trial run. This is almost better than attempting to figure the coal consumption, as it will give positively the exact cost. We would point out also that in figuring operating expenses, the municipality must be as liberal as they were conservative in estimating the revenue, and if the former is a reasonable amount below the latter, they can at once approach the power consumers and offer them a definite price. If, on the other hand, the operating cost exceeds the prospective revenue, the councillors may be quite sure that the proposition of a day service is a losing one.

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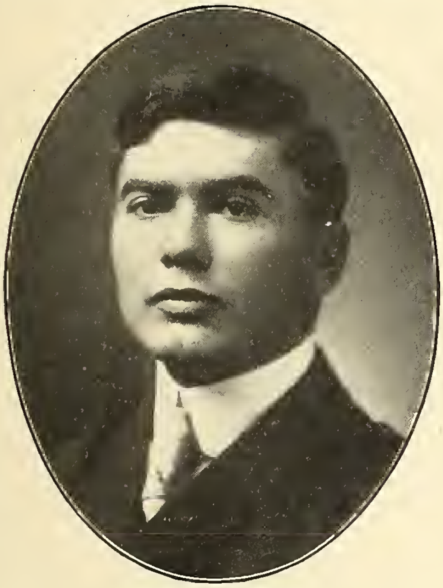
which will hold an Electrical Exhibition in Montreal next September.

ENGINEERING SOCIETY PRESIDENT.

Mr. Thomas H. Hogg, who has been recently elected to the presidency of the Engineering Society of the Faculty of Applied Science, Toronto University, was born in Chippawa, Ont. For the past few years he has been connected with the Ontario Power Company, Niagara Falls, but during the college term has been taking the course in civil engineering.

An evidence of Mr. Hogg's ability is the fact that he has twice led his class in the faculty annual examinations. For the office of president of the society no better or more suitable man could have been chosen. He is energetic and resourceful, and the coming year for the Engineering Society should be one of great interest.



MR. T. H. HOGG,
President Engineering Society, Faculty of Applied Science, Toronto University.

COST OF ELECTRICITY OBTAINED FROM WATER, STEAM, GAS AND OIL.

At a meeting of the New York section of the American Electrochemical Society, held on February 26, Prof. Charles E. Lucke presented a paper discussing in detail the various factors which enter into the cost item of the energy consumed in electrochemical industries. The author discussed the electric generating station, in which the source of power is water, oil, steam or gas. In each case commercial sizes of machines were chosen. The oil engine driven station was assumed to contain six 160 kw. units, four of which were to be in use constantly, the other two being held as reserve. In the gas engine driven station it was assumed that six 600 kw. units were installed, two of which were held as reserve. The steam station was assumed to contain six 500 kw. units, four being in use constantly. In the water power station the units installed were assumed to be operated continuously at full load. The initial cost of the installation was found to vary from $75 to $200 per kw. for the water station, and from $110 to $150 per kw. for the steam station, for either reciprocating engines or steam turbines; while the equipment in the oil engine driven station were estimated to cost $217 per kw., and that in the gas engine driven station $270 per kw. In each case it was further assumed that the total investment cost per year per kilowatt could be taken at 10 per cent. The operating cost was estimated from values found to exist in practice. On the basis of the above assumptions the author presented the following table, showing the cost of electrical energy obtained from the various sources, the values being in dollars:

	Water		Oil	Steam		Gas
	Min.	Max.	Mean.	Min.	Max.	Mean.
Initial cost per kw	75.	200.	217.	110.	150.	270.
Investment cost per year per kw	7.5	20.	21.70	16.5	22.5	27.0
Operating cost per kw-yr. .	1.	5.	56.9	52.5	52.5	38.5
Total cost of energy per kw-year	8.5	25.	78.6	69.	75.	65.5

In discussing Prof. Lucke's paper, Mr. H. G. Stott called attention to the fact that the actual proportion of operating charges to fixed charges will vary largely with the load factor of the station. Thus, with a 50 per cent. load factor, such as is common in railway service, the operating expense would be 61 per cent., the fixed expense 33 per cent., and other expenses 6 per cent., while with a 20 per cent. load factor, such as is common in lighting equipments, the operating expense would be 30 per cent., the fixed expense 60 per cent., and other expenses 10 per cent. It is seen, therefore, that in comparing various stations, it is extremely important to consider the load factor. Moreover, it is not proper to assume that the cost of operating steam turbines is the same as that for reciprocating engines. As a matter of fact, while three men are required for each 5,000 kw. engine unit, one man can care for two 5,000 kw. turbine units. The maintenance charge of a turbine will be perhaps one-fifth of that for an equivalent reciprocating engine. The load characteristics of a steam turbine are quite different from those of a reciprocating engine. On account of the leakage past the blades, the turbine has a lower efficiency at light load than has the engine, but it can carry enormous overloads with a very much higher efficiency than can the engine.

Mr. F. G. Clark, in discussing the variation of cost of energy with the load factor of the station, remarked that while with a load factor of 100 per cent. the cost would be $35 per kw. year, at a 40 per cent. load factor the cost would be $65 per kw. year, and at a 20 per cent. load factor the cost would increase to $100 per kw. year. He drew attention to the fact that in comparing gas and oil engines with steam engines one should not neglect to consider that steam engines and steam turbines can carry enormous overloads, while gas engines and oil engines are limited to about 25 per cent. overload. Therefore, it is not necessary to carry as much excess capacity in a steam equipment for peak loads as would be true with either a gas or an oil equipment. In the case of steam equipments it is possible to use water heat storage for equalizing the load on the boilers. Thus, immediately preceding the peak load it is possible to have the boilers filled with water at a high temperature and to shut down the feed pumps while the peak load continues, and depend on utilizing the energy stored in the heated water for the excess capacity demanded during the peak.—Electrical World.

WAIT FOR TEN YEARS.

Discussing the electric lighting venture of the Kingston Council, the Whig remarks that enough has transpired already to make people feel that a great responsibility has been incurred in investing hundreds of thousands of dollars in property and putting it under municipal management. The Whig should be patient. In about ten years it will have real cause for worry.

THE APPLICATION OF THE STORAGE BATTERY TO LIGHTING, POWER AND RAILWAY SERVICE.

By J. M. S. Waring.

For convenience, batteries for lighting, power and railway service may be divided into two general classes under the headings, (a) batteries for railway and power service; (b) batteries for lighting service. These headings may be again subdivided and the functions of the batteries given under these latter subdivisions, as follows:

(a) Railway and power service.

1. Power house or sub-station batteries.
   Current regulation, peak work, current regulation and peak work, emergency service.
2. Line batteries.
   Current regulation, peak work, current regulation and peak work, improving line voltage, effecting copper saving or offsetting a rotary sub-station, emergency reserve.

(b) Lighting service.

1. Central or sub-station batteries.
   Peak work, emergency reserve, voltage regulation, equalizing.
2. Line batteries (battery sub-station).
   Peak work, emergency reserve, voltage regulation, improving line voltage, effecting copper saving or offsetting rotary sub-station, equalizing.

In order to maintain a predetermined rate of charge or discharge on any particular storage cell, the E. M. F. of the source of supply or demand must throughout the charge or discharge of the cell be increased or decreased, so as to conform to the curve of charge or discharge at that particular rate. Automatic regulation is necessary where batteries are required for current regulation; that is to say, to relieve the power house or sub-station of sudden fluctuations continuing for only a short period. This automatic regulation is accomplished by means of boosters, the regulation shunt booster being used for power house and sub-station work, the constant current booster for certain classes of power work where the generators are required to supply a lighting load and a fluctuating power load, and the compound booster for operation in junction with the line batteries. The automatic regulation of charge and discharge of line batteries, floating without boosters, can be accomplished by means of the drop in the line between the power house and the battery.

The carbon regulator is used for automatically varying the strength of the booster fields and also for changing the direction of current flow in these fields.

Hand regulation accomplished by means of a rheostat control of the booster fields in cases where boosters are installed in railway and power work.

In lighting service, where the batteries are not required to respond to rapid load fluctuations, but are required to discharge continuously for comparatively long periods of time, hand regulation is accomplished by means of end cells, additional cells being cut in series in the battery as the discharge continues, no booster being used for discharge regulation.

In railway power house, the batteries by relieving the station of fluctuations allow the engines in service to operate at a steady and economical load. By performing this service the battery increases the capacity of the station and materially improves the load factor of the units in operation. Particularly in small railway stations, the fluctuations are so great that they necessitate the operation of more units than would be required if the generating apparatus only had to supply the average load. Since the battery, the generating apparatus is only required to supply the average load, the battery caring for all fluctuations above and below the average, by means of a battery the station can be operated with fewer generating units, thereby eliminating the constant losses of the machines that can be shut down.

In interurban service, where batteries are installed in the sub-station, not only the power plant but the rotaries, static transformers, high tension transmission lines, alternators, engines and boilers are relieved of the load fluctuation with a consequent improvement of the load factor on the system. In small water power plants, the regulating feature of the battery is important, since by removing the load fluctuations the maximum output may be obtained from the water power.

Line batteries doing fluctuating work not only afford relief to the power house, but frequently save more than their cost in feed wire, or where the average load of a line is comparatively small the battery will often offset a rotary sub-station. As line batteries of this type require no regular attendant, by offsetting the sub-station, a material saving in labor is effected. The value of the line battery as against additional copper lies in the fact that the copper with the battery has only to carry the average current, while without it sufficient copper must be installed to transmit the maximum current with a drop in voltage, which will not be prohibitive to good operating conditions.

In larger railway work, such, for instance, as the surface and elevated roads in large cities, where a pronounced peak occurs during the rush hours in the morning and evening, batteries, besides regulating the load fluctuations, are required to discharge continuously during the peaks, thus relieving the power plant at this time. In a number of cases by installing the peak batteries on the line instead of at the power house they not only relieve the power house but also the feeder system of load during the peak. As an example, a road in Chicago installed a large line battery of this type, thereby effecting a copper saving equal to the cost of the battery. These peak batteries are particularly valuable in cases where the operating company is buying water power. Since water power rates are based, broadly speaking, on a maximum demand basis, by reducing the peaks the rate for the water power can be reduced to an amount that will more than cover interest and maintenance on a storage battery.

In lighting work, such as Edison service, in the larger cities, practically the same arguments for storage batteries for peak work hold as in railway work. The emergency values of the batteries, however, are greater in this service than in railway work, as they are always available for sudden unforeseen demands for power, such as occur on dark days, when the batteries may care for the rapidly increasing load until

additional generating apparatus can be placed in service. In cases of breakdowns in any part of the Edison system they are also of great value.

The battery sub-stations, which are more or less analogous to the line battery on railway work, are usually located at distributing centres; by discharging during the peak they not only afford relief to the power house, but reduce the supply of power sent over the mains during the peak. In this connection the battery is also available as a means of regulating the voltage at the centres of distribution.

EXPERIENCE WITH MAGNETITE ARC LAMPS.

The streets of Harrisburg, Pa., were formerly lighted by open arc lamps operated by the old Excelsior and T-H systems. A little over a year ago the Harrisburg Light, Heat & Power Company, which has the contract for the public lighting, ordered 800 magnetite arc lamps and six 140-light, 4-ampere Brush arc machines, and at the same time made arrangements for changing over the street lighting system just as soon as the dynamos were placed in position. In December, 1905, according to the Electrical World, the first machine was delivered, and as the lamps were received they were placed in position, until now there are 761 magnetite lamps in circuit, of which 503 are on public street circuits and the remainder on commercial circuits.

The lamp, which has been only recently introduced, is suitable only for outdoor use, and possesses for this purpose a number of advantages. A comparatively high efficiency is obtained, together with an improved distribution of the light, and the color of the latter is very white. The lamps are designed for operation on direct-current series circuits at 4 amperes and 75 to 80 volts, which may be supplied by Brush arc machines, as is done at Harrisburg, or by mercury arc rectifiers connected to alternating-current circuits. The lower electrode is of specially prepared composition (magnetite), contained in an iron tube, and has a life of 140 to 160 hours. The upper electrode is of copper, so designed as to remain at a comparatively low temperature, and has an estimated life of about 4,000 hours. The main frame of the lamp consists of a single tube, which serves as a chimney for carrying away the fumes of the arc. Inasmuch as the position of the arc does not change as the lamp burns, the lamp has been designed with a small horizontal reflector of white enameled iron placed inside the globe and close to the arc.

Adjustments are few and easily made. The length of the arc is controlled by an adjustable stop on the left-hand guide rod. The starting, or pick-up voltage is approximately 75 volts. To increase the arc voltage the stop is raised, and to decrease the voltage the stop is lowered, after which the lower electrode is tripped and then pushed up again as in trimming. The shunt magnet is adjusted by raising or lowering the armature disc and the check nut. If the lamp feeds too often, the disc is turned to the left, and if not often enough, the disc is turned to the right. The shunt magnet is in multiple with the arc and should close the contacts when the arc voltage rises momentarily to 110 volts. This occurs when the average voltage is approximately 80 volts. The positive, or upper, electrode is free and has one eighth inch play between the top of its wing and the top of the slot on the iron box through which it moves. The armature and lower electrode drop back at least three-sixteenths of an inch instantly before retarded by the dash pot. The spring which is fastened to the lever of the lower clutch has enough tension to keep the toe of the clutch engaged with the electrode holder rod, but does not prevent the body of the clutch from resting on the lower guide plate.

In trimming, the outer globe is unlatched and the tripping rod pushed up until the clutch in the lamp is disengaged. The old electrode is then readily removed and replaced, care being exercised to have it align with the centre of the positive electrode. If the electrodes are not in line the arc will play from one side of the upper electrode and give poor operation. The lower electrode mechanism is then thrust up until the electrodes come in contact and drops freely when the hand is removed. It is necessary at every trimming to clean the centre tube with a small brush, as otherwise the reddish-brown fumes accumulate and clog the tube and settle on the inside of the globe, making it opaque. The negative electrode is five-eighths of an inch in diameter and is eight inches long. The upper electrode is reversible, with an approximate life of 40,000 hours.

When the lamp is started, the current passes through the starting magnets and carbon contacts of the cut-out, thence through the starting resistance to the line. The starting magnets become energized, lifting the lower electrode until it comes in contact with the upper electrode, when the current flows through the electrode circuit in which is the series magnet. This magnet becomes energized, separating the carbon contact and cutting into circuit the shunt magnet. The weakening of the starting magnets allows the lower electrode mechanism to fall until supported by the clutch. The lamp burns in this position until the lower electrode has been consumed, so that the increased arc voltage will cause the shunt feeding magnet to close the carbon contacts. The starting magnets are again energized, raising the lower electrode until both electrodes are again in contact.

From careful records kept by the Harrisburg Light, Heat & Power Company, the cost of maintaining the electrodes is $1.60 per lamp per year. The repairs and renewals were abnormally high, for the reason that the company changed the entire outfit so as to use a new type of electrode, the old electrode having a rocker arrangement. This change brought the yearly cost of repairs and renewals up to about $2.00 per lamp. With the equipment in the Harrisburg station it is found that unless the machine is turned on with a jerk or made to flash so as to throw a sort of shock on the line, all the lamps will not start. This is due to minute particles of magnetite getting between the electrodes and acting as sort of insulators. By causing the lamp to flicker a number of times the arc is finally struck.

Since the lamps are trimmed only every 150 hours, or every 10 or 12 days, the accumulation of reddish-brown dust at the end of that time, while slight, is still sufficient to absorb much light. The company has found that the quickest way to clean this from the globes is by the use of cheese cloth dampened with coal oil. The company has also found that it is necessary to use care in centering the electrode in the chimney, as at first much unsatisfactory operation was traced to this cause. The lamps are quite heavy, weighing about 50 pounds each, and are hung rather low. The reading distance, as compared with open or enclosed arc lamps, is increased one-third. The cost of maintenance is not so great, and with the 761 lamps connected in circuit, only one man is required to trim all the lamps. It is the opinion of Mr. Kinter, the manager of the Harrisburg Light, Heat & Power Company, that the lamp is as far ahead of the enclosed arc lamp as that lamp is ahead of the old Excelsior arc lamp.

Lightning Phenomena in Electric Circuits.*

By C. P. Steinmetz.

In its most general meaning, as understood now when dealing with electric circuits and their protection, lightning denotes all phenomena of abnormal voltage and abnormal frequency. The lightning phenomena in electric circuits comprise: External lightning, the disturbances due to atmospheric electricity; internal lightning, the disturbances due to defects of the circuit or its operation, etc.; surges, that is, disturbances in the flow of generated power, brought about by the external or internal lightning and depending for their energy on the power of the generator system, hence frequently destructive.

The potential difference against ground, or pressure of the total electric circuit, may gradually rise by an electric charge accumulating in the circuit. The electric charge discharges across the lightning arresters, or punctures the insulation, whichever is the point of least resistance.

Some causes of such steady and gradual accumulation of electric charge and of potential difference against ground, of an electric circuit, are: (a) Collection of static charge from rain, or snowdrift, or from fog, carried by the wind across the line, when the electrostatic accumulation of charge, in the case of efficient lightning protection, may appear as a series of discharges over the lightning arresters, which periodically follow each other; (b) electrostatic induction from a passing cloud; (c) potential differences between line and ground, due to differences of atmospheric potential in different regions traversed by the line, especially if the line passes through different altitudes, as valleys and mountain ranges; (d) accidental electrostatic charges entering the circuit, as friction electricity from the belt of belt-driven machines; (e) unsymmetrical conditions of the generator potential; (f) existence of higher harmonics in the electromotive force wave of a polyphase system, of such order that they coincide in the different phases, that is, the whole system rises and falls with their frequency; so in a three-phase system, the third, ninth, fifteenth, etc., harmonics coincide and may cause trouble, where they appear, as, for instance, by star connection or primaries and secondaries of transformers with grounded neutral.

The danger of such accumulations of potential lies in their liability to damage the insulation of the system by puncture, and in their liability of producing, by their discharge, other and more serious disturbances. In taking care of them by lightning arresters arranged to discharge at a safe margin of voltage above the normal, the main prbolem is to arrange the discharge path so that the discharge passes harmlessly, that is, without producing other disturbances. It is the same problem as in the protection of a water power station against freshets by dam and overflow, safely to discharge the water by means of the overflow.

The effects of steady electrostatic stress, whether unidirectional or alternating, appear not only in its own circuit, but also in circuits in inductive relation thereto, and may even be more serious in secondary circuits.

In connection with the impulse or traveling wave, a sudden local electrostatic charge of a transmission line, as by a lightning stroke, or inductively by a lightning flash suddenly discharging a cloud or any other sudden local change, produces a wave of potential and of current which runs along the line, just as a water wave over the ocean surface. Such a potential wave or impulse is very high and of steep wave front at its starting point or point of impact, but gradually broadens and flattens out, and ultimately disappears, if the line is of unlimited length, just as the wave produced, for instance, by throwing a stone into a body of water, is steepest at the point of impact and gradually flattens out and disappears.

When reaching the station—generating or substation—such a traveling wave is partly reflected by inductance of reactive coils, transformers, instruments, etc., partly transmitted. The different reflected and transmitted waves superpose upon each other, that is, the impulse is broken up into a number of secondary impulses, and local standing waves, which may reach voltages far higher than that of the traveling wave, just as an ocean wave when approaching the beach is broken up into the surf, with wave crests far exceeding in height that of the unbroken wave. The complex system of phenomena resulting from the approach of a traveling wave to a station is analogous to the breaking up of an ocean wave into surf, and may indeed be called "electrical surf." While individual effects, as the formation of high-frequency standing waves or oscillations from an electrostatic impulse entering a circuit of inductance and capacity, the effect of an inductance in the path of an impulse, the phenomena occurring at a branching point between two circuits, etc., can be calculated, the complete predetermination of all the electrostatic and electromagnetic effects of an electric wave entering the complex system of circuits of a station is no more feasible than the exact calculation of the motion of the water particles of an ocean wave when it breaks as surf at the beach.

The breaking up of an impulse or a series of impulses or traveling waves, in entering a station, appears as electrostatic displays, sparks, streamers and brush discharges, at conductors, switchboards, etc., the so-called "static," which signals in the station the existence of a disturbance on the line.

Some of the causes of traveling waves are: (1) Direct or secondary lightning strokes entering the transmission line, usually giving a single impulse, or very few impulses, of extreme steepness of wave front, but short extent, and capable of exerting very considerable power only locally, but not after traveling considerable distance, that is, a direct lightning stroke may shatter several poles, but do no damage to the station, if not very near to it; (2) electrostatic induction by the clouds; (3) discharges of slowly accumulated potential, resulting in a series of successive impulses; (4) any spark discharge from the line to

*Abstract of a paper read before the American Institute of Electrical Engineers, New York, March 20th.

another line or to the ground; (5) an arcing ground on one phase of an insulated system, or, in general, the existence of a "self-rupturing arc" in the system; (6) sudden changes of load, connection and disconnection of apparatus, etc., as when connecting a dead transformer to the system an impulse traverses the transformer; and usually penetrates beyond the transformer into the circuit.

An oscillation of a transmission line is a complex wave, containing fundamental and higher harmonics. The relative proportions of the different harmonics in the oscillating wave depend upon the distribution of potential and of current at the moment of the start of the oscillation. If the distribution of potential and of current at the start of the oscillation were perfectly sinusoidal, only the fundamental wave would appear. The more irregular the distribution is, the more prominent are the higher harmonics; with a very irregular and abrupt distribution, the fundamental wave does not appear at all, but only higher harmonics.

Standing waves or oscillations in electric circuits vary from the very low frequency of the fundamental surge of very long transmission lines, which approaches commercial alternating current frequencies, to frequencies of several hundred million cycles per second, in the discharge oscillation between the cylinders of a multi-gap lightning arrester. Due to this enormous range of frequency, the physical effect of the oscillation also varies greatly. In very high-frequency oscillations the power is very small; the electrostatic effects, as luminous glow, brush discharge, streamers and sparks, are prominent, but the direct damage usually insignificant, and the effect local. Inductance opposes a fairly effective barrier. On the other extreme, low-frequency surges show little or no luminous display; inductance offers no obstruction, but, due to their high power and wide extent, considerable damage may be done all over the system. Oscillations, therefore, are frequently subdivided into high-frequency oscillations, in which the lower harmonics are absent, and low-frqeuency oscillations, in which the fundamental predominates. The name surge is frequently applied to denote the latter.

The problem of lightning protection is threefold:

(1) Prophylactic; to guard against the entrance or origin of disturbances; (2) restrictive, to guard against a disturbance leading to other disturbances; (3) curative; to discharge a disturbance harmlessly. The problem is a vast one, and comprises nearly every part of design, installation and operation of the system.

The seventh annual convention of the National Electrical Contractors' Association of the United States will be held new New York City, July 17th, 18th and 19th.

At the annual meeting of the Ontario Lantern & Lamp Company, Limited, Hamilton, Ont., the officers elected were:—President, W. H. Ginder; vice-president, F. W. Gates; secretary-treasurer, W. S. Moore. The company have almost completed a three-story brick addition to their plant The lower floor will be used for a shipping room, the second for plating, and the third will be equipped with automatic machinery for making all kinds of burners.

STANDARD SPECIFICATIONS FOR INCANDESCENT LAMPS.

The Association of United States Government Electrical Engineers and a number of representatives of the leading incandescent manufacturers of the United States held an unofficial meeting on February 25, 26 and 27, at Washington, D. C. A set of standard specifications covering incandescent lamps used by the United States government was discussed, the specifications as prepared being practically adopted, with the exception of a few minor points. These will be given further consideration by a committee.

MACDONALD ENGINEERING BUILDING BURNED.

The Macdonald Engineering Building of McGill University, Montreal, erected, equipped and endowed by Sir William C. Macdonald, was totally destroyed by fire on April 5th. The loss is estimated at $700,000, while the aggregate insurance amounted to $420,000. The building was five storeys and was greatly admired for its architectural beauty.

The electrical laboratory was very completely equipped, and, in addition to dynamos, motors, etc., contained testing instruments and devices for experimental and research work which it will be difficult to replace.

The loss to McGill is serious, but from the ashes will no doubt rise a Macdonald Engineering Building greater and grander than the one destroyed.

THE EYE VS. THE EAR.

Scientists recognize that most people remember more of what they see than of what they hear.

Talk to a man an hour when he's busy, and what's the result? You've taken up his time, and your own; you've tried his patience and probably made him sore on you—and what is worse, on what you represent. Fully three-quarters of what he has heard is soon forgotten.

Has it ever occurred to you that there is a better way—a more effective way? Approach him when he is in repose, when his thinking faculties are clear, when his mind is restful and retentive.

That's the time to present your argument—show it to him in black and white—present it through the medium of his eyes, rather than through his ears and it is not forgotten. A clear, convincing argument, with facts briefly, but fully and truthfully stated, is certain to bring enquiries. Judicious advertising does pay.

Messrs. Laurie & Lamb, Canadian representatives for the "Foster" superheater, advise us that the International Harvester Company have just placed a contract for "Foster" superheaters to be installed in twenty 350 h.p. Sterling boilers, and the Copper Queen Consolidated Mining Company for superheaters in eight Sterling boilers of 400 and 450 horse-power.

The cost of suction gas power is discussed in the Electrical Review by Mr. R. Weaving, who gives figures based on the working of a plant under his charge. It consists of three gas-driven generating sets of 50 kw. each, which have been running over two years for operating machine shops. The engines are direct-coupled to generators, and are governed by hit-and-miss gear, with an additional throttle governor on the gas inlet. The gas for the three engines is derived from one suction plant. The fire is banked at week-ends, and put out only at two months intervals. A month's running showed the following: Coke, 22¼ tons, £13 18s. 2d.; water, 106,500 gal., £2 4s. 5d.; wages, £16 15s. 4d.; oil, £1 13s. 6d.; sundries, 15s.; scrubber and purifier renewals, 5s. 6d.; interest and depreciation, £22 10s.; total, £58 1s. 11d. The coke burned per horse-power-hour was 2.22 pounds.

INVENTION and DEVELOPMENT
IN THE ELECTRICAL FIELD

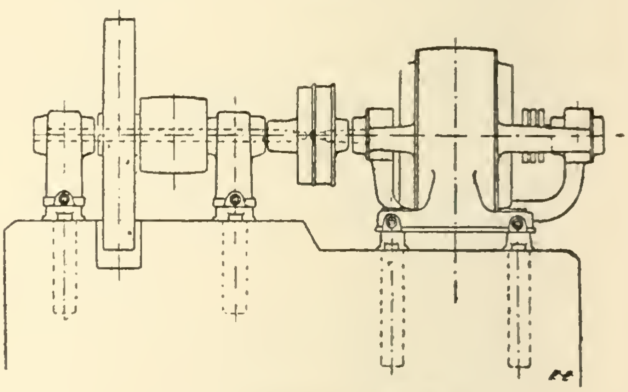
Helios Flaming Arc Lamp.—A new type of flaming arc lamp has been placed on the market by the Helios Manufacturing Company, Bridesburg, Philadelphia. The main structure of the lamp consists of a heavy brass tube connecting the lower brass plate with the top casting, and to which is secured a casting which supports the resistance spools and the carbon-holder guides. Inside of the main tube is a rod operated by a magnet in the top of the lamp, which is energized when current is thrown on, drawing the rod upward; and thus, by means of a presser foot at the lower end of the rod, separating the carbons and striking the arc. The blowing magnets, as well as the plunger magnet, are wound with asbestos-insulated wire. The flexible cables leading to the carbon-holders are insulated with glass beads. The resistance spools are wound on grooved porcelain forms.

There are no clutches, chains, gears nor shunt windings in this lamp. The carbons feed entirely by gravity, and the bridge connecting the carbon-holders insures equal feeding of the two carbons. The binding posts are substantial. The cases are made of either brass or bronze, in any desired finish, for either indoor or outdoor use. The special-shaped globe is so designed that the light rays will pass through it nearly at right angles—that is, the shape of the globe is designed to follow practically the shape of the arc itself.

These lamps require forty volts at the arc, and may be operated two in series on 110 volts. When so operated and adjusted for a current consumption of ten amperes, the manufacturer states that the lamps have an efficiency of one-quarter watt per mean hemispherical candle.

Electrical Music.—One of the interesting electrical events of the past year was the formal opening of the auditorium of the Eastern Cahill Telharmonic Company in New York City, and the electric music distribution service of that company. This service is through underground cables, just as electric light, telephone, and telegraph service is now conducted in large cities, affording music on tap, so to speak, with the company's establishment at Broadway and Thirty-ninth street as the central music generating station. This is equipped with 144 alternating generators, and yields 144 different frequencies, varying from 40 to 4,000 cycles. The currents from these alternators are superposed in a manner to cause a telephone diaphragm to produce certain musical notes, according to the combinations of frequencies used. A performer's keyboard, somewhat on the piano order, with 144 keys, controls the circuits from the several alternators. From this music "central" the music is carried off by wire to thousands of different places simultaneously. Contracts are now being made and connection on the company's cables as well—material illustrations of Dr. Thaddeus Cahill's beautiful and epoch-making invention.

Electrical Driving in Sawmills.—Woodworking machinery, such as circular saws, planers, etc., often demands a sudden increase in driving power up to as much as three times the normal, and with the ordinary arrangement of motor drive this leads to objectionable voltage fluctuations and prevents satisfactory lighting off the same circuit. The effects can be minimized by the introduction of suitable flywheels, but data on the subject are not easily obtainable. Herr J. Reiner describes a case in Elektrotechnik und Maschinenbau in which a complete cure was effected in this way: The flywheel was attached to the motor, as shown in Fig. 1, by means of a leather coupling. The dimensions of the flywheel were such that its



Electric Driving in Saw Mills.

stored energy amounted to 15 times the full-load motor output in one second, and this served to equalize the combine power fluctuations due to the circular saw, shaping machine, and planer, so that these machines could be run without inconvenience during the lighting period.

Vertical Frequency Changer Set.—What is stated to be the first vertical shaft frequency changer set ever built in the United States, and probably in the world, has recently been completed at the Schenectady Works of the General Electric Company. The advantages of applying vertical turbo-generator principles to frequency changer sets have been found to have great weight in the larger capacities. Whereas, in large siz horizontal shaft frenquency changer sets, it has followed that the electrical design suffered because of the mechanical difficulties involved, in the new vertical sets, the machines can be properly proportioned to obtain low iron and copper losses without sacrifice to either.

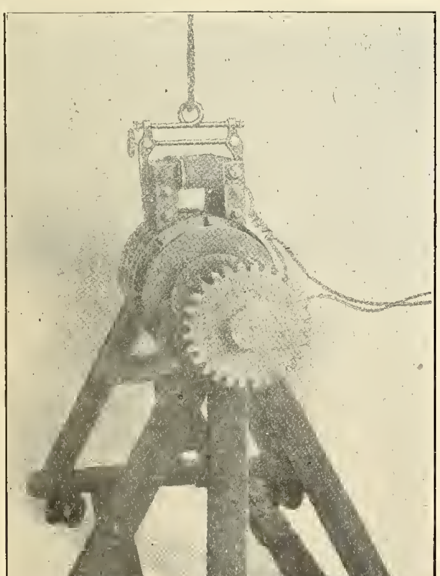
From the facts that the friction losses are small and the proportion between iron and copper losses so low and well balanced, the combined efficiencies of the motor and generator in the vertical sets are very high. Tests have shown that the generator is suitable for a continuous output of 2,667 kilo-volt-amperes of 75 per cent. power factor without any part heating more than 40 degrees above the surrounding air. At the full load output of 2,000 kw. with unitl power factor, the efficiency is 85 per cent. The high efficiency of

the vertical set at full load, and remarkably high efficiency at half load are due, in a good measure, to the very low friction losses. The rise in potential of the generator when the load is thrown off, with unity power factor, is a trifle less than 6 per cent.

Aside from the higher efficiency thus obtainable, the vertical frequency changer set in the larger sizes is more compact, simpler in operation, cheaper to build, more accessible, and more adaptable to given conditions than the horizontal type heretofore built.

Electric Regulator Socket.—A new type of turn-down or regulating socket has been placed on the market, wherein it would seem that the correct principle of adapting the wire wound rheostat form of resistance has been solved. Heretofore the usual method was to use some plastic material, which would disintegrate from the heat. The "Electric Regulator Socket," so termed by the manufacturers, the Knapp Manufacturing Company, New York, is compact in form and but slightly larger than the ordinary socket. According to the Electrical Record, it is claimed that when turned down on the lowest contact, over two-thirds of the current is saved by the device. This socket is constructed for any voltage from 240 down, alternating or direct current, and any commercial lamp of 16 candle power.

An Adjustable Transformer.—The use of a small alternating current transformer for testing armatures to discover short circuits is becoming common prac-



An Adjustable Transformer.

tice in electric railway shops. Most roads having several sizes of motors and armatures have several sizes of transformers to accommodate the various circumferences. Mr. G. A. Harvey, electrical engineer of the International Railway Company, of Buffalo, has designed a testing transformer which accommodates itself to any size of armature up to 18 inches in diameter. It consists of the usual coil of wire around a core, and to each end of this core is bolted, so as to form a hinge, the series of laminated plates forming the sides of the transformer. From the engraving shown herewith it will be evident that by turning the small hand screw the sides of the transformer may be spread apart or brought together so as to fit a larger or smaller armature.

Compensating Windings for Dynamos.—A method of winding compensating coils for dynamos, which is thought to have some advantages, has been devised by C. A. Parsons and J. H. Armstrong, of England. It is sought to overcome the difficulty of bending large conductors, placing them in slots cut in the face of the field poles without injuring the insulation. This is accomplished by building the conductor up of a large number of copper links bolted together, each link being of suitable length. These links are then insulated and placed in slots in the pole face, the arrangement being such that every armature conductor in every position is paralleled by one of these compensating conductors, the latter being arranged so that the centre of each compensating coil comes midway between two adjacent poles. The coils are connected in series with the armature, and in this way set up an opposing magnetomotive force which at all times is equal and opposite to that due to the armature.—Abstracted from the Mechanical Engineer.

TIDE WATER POWER.

Inventors have been working for years to create some system of harnessing the tides, but there is usually some drawback. In most of the systems which have been tried, the inventors could not get any power at extreme high and low water.

Messrs. George H. Cove, of Roxbury, Mass., and W. Fred. Cove, of Amherst, N.S., have recently obtained patents on a tide water power system, on which they have been working for years, and which recognized engineers claim is the best and most practical system yet invented. By their system it is claimed they can get continuous power night and day.

A company, which is known as the Cove Hydro-Electric Company, has been incorporated under the laws of the State of Maine. Their main office is located in Boston, Mass., and they have opened a branch office at St. John, N.B.

In Nova Scotia and New Brunswick a tide of from twenty to forty feet furnishes such an enormous force that the possible energy is almost inconceivable, yet the same force remains to be reharnessed day after day for the ages to come.

Mr. W. Allan Staples, of Fredericton, N.B., has been appointed consulting engineer.

ELECTRIC SMELTING OF ORE.

The representations to the Government in favor of a bounty on iron ores smelted by electricity are likely to be successful. The Government's proposal is as follows:

On pig iron manufactured from Canadian ore by the process of electrical smelting during the calendar years 1909-10, $2.10; 1911, $1.70 per ton; 1912, 90 cents per ton.

On steel ingots manufactured by electric process direct from Canadian ore, and on steel ingots manufactured by electric process from pig iron smelted in Canada by electricity from Canadian ore during the calendar years 1909-10, $1.65 per ton; 1911, $1.05 per ton; 1912, 60 cents per ton.

A.I.E.E. ANNUAL MEETING.

The annual meeting of the American Institute of Electrical Engineers will be held at Niagara Falls, N. Y., June 24 to 27.

TELEGRAPH and TELEPHONE

MEMORIAL TO PROFESSOR ALEXANDER GRAHAM BELL.

The citizens of Brantford, Ontario, have formed the Bell Telephone Memorial Association, for the purpose of purchasing as a public property the Bell homstead on Tutella Heights and erecting a monument on a central site in the city of Brantford to perpetuate the memory of the inventor of the telephone, Professor Alexander Graham Bell. The amount required to be raised is estimated at $40,000, of which the Ontario Government has been asked to contribute $10,000.

Thirty-one years ago the first long distance telephone message on record was transmitted from Tutella Heights, the home of the inventor, to a point in the city of Brantford, a distance of about three miles. It was there that many of Professor Bell's experiments in multiple telegraphy, and some of the earliest in telephony, were made. Concerning these experiments, Mr. L. B. McFarlane, in a paper read before the Canadian Electrical Association in 1893, said:

"The first experimental telephone lines erected in Canada and used in this connection, extended from the residence of the inventor's father across his garden. This line being found workable, it was afterwards continued on to the residence of the Rev. Thomas Henderson, in Brantford. Its successful working soon became noised abroad, and the novelty of the invention attracted many visitors from various parts of Ontario to listen to the then wonderful performance of the electric telephone; and presently Brantford became known as the 'Telephone City.' At this time the much-condemned 'Hello' had not come into use as a signal for conversation to begin; the words 'Hoy Hoy' were considered most satisfactory. We must give a discriminating public the credit of choosing the less objectionable word, and be thankful that 'Hoy Hoy' did not survive.

"When the Canadian patent was issued to Prof. Bell, he presented it as a gift to his father, Prof. Melville Bell, and the latter, believing a company or partnership unnecessary, appointed a general agent to exploit the Bell Telephone. The latter visited the principal cities and towns and exhibited the old-fashioned box telephone, with but little commercial success, however, as the difficulty of hearing the voice clearly rendered problematic its future value as a means of communication.

"The first commercial telephone line was established at Hamilton, Ontario, in October, 1877, by the District Telegraph Company, who were quick to appreciate its value, and they therefore secured control of the invention for that district. This line connected together the residences of Messrs. Baker and Cory."

Professor Alexander Graham Bell,
The Inventor of the Telephone.

Homestead of Professor Bell, the Inventor of the Telephone,
Tutella Heights, Brantford.
(Photo by Park & Co.)

WIRELESS TELEPHONY.

Count Arco, of Berlin, in his wireless telephone experience, has succeeded in obtaining distinct exchanges of words in a tolerably natural voice at a distance of two miles by using poles thirty feet high. Rear-Admiral Manney, who was a delegate of the United States to the International Conference on Wireless Telegraphy at Berlin, and Lieut.-Commander Howard, U. S. N., the American Naval attache, have been present at a series of private exhibitions of the wireless telephone apparatus, and have been able to talk with each other at a distance somewhat less than three miles. But the best practical results are attained at two miles or under, with thirty feet poles.

Count Arco does not regard his discoveries as commercially practicable at present, though he hopes to eventually construct an apparatus which will take the place of wires in cities and perhaps in suburban districts.

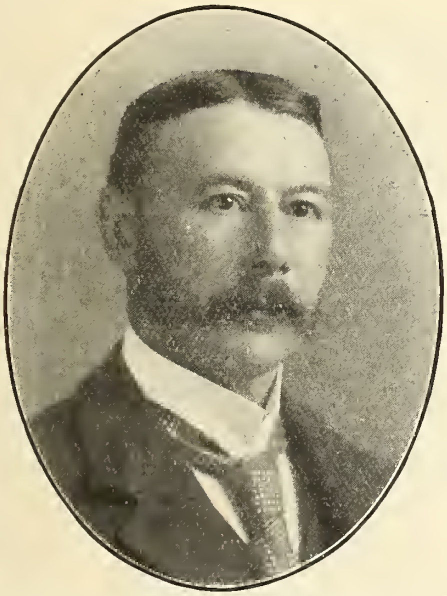
The Hamilton Rural Telephone Company, Limited, capital $10,000, has been granted an Ontario charter, to carry on a telephone business in the county of Northumberland. The head office will be at Coldsprings, Ont. The directors are Messrs. Frederick Arthur George Nixon, William Edwin Lacey, David McIntosh, James Thompson and Thomas William Moore.

THE LATE CHARLES P. SCLATER.

The death of Mr. Charles Page Sclater, secretary-treasurer of the Bell Telephone Company, which occurred at Montreal on March 25th, came as a great surprise to his friends and the business community. A slight influenza developed into pneumonia, and in a few hours the end had come.

Although but fifty-seven years of age, Mr. Sclater had been secretary-treasurer of the Bell Telephone Company for twenty-seven years, since its incorporation in fact, and no small share of the admirable manner in which that great business is organized is due to his fine abilities as an accountant. His associates in the company's service hold him to have been one of the first men in the country, in his own particular work. He had a remarkable faculty for organization, and the comprehensive system under which the books and accounts of the company are kept is practically his own creation, he having had charge of them from their inception.

Mr. Sclater was born on February 2nd, 1850, at Dover, England, the son of a retired officer of the



THE LATE CHARLES P. SCLATER,
Secretary-Treasurer of the Bell Telephone Company.

Royal Navy. He was educated at a private school in England, and on its completion, was articled to a firm of London accountants, Messrs. Kemp, Ford & Company, with whom he obtained a thorough grounding in good business methods.

In 1876 Mr. Sclater left England and assumed the management of a cotton business in South Carolina, but a year later he came back under the British flag and invested in the oil wells of Petrolia, Ont. He was appointed acting secretary of the old Dominion Telephone Company of Toronto in 1879, and when the Bell Telephone Company was formed in 1880 he became its secretary-treasurer, which position he has occupied until his death.

Mr. Sclater was connected with a number of other important commercial corporations, and was a director of the Northern Electric & Manufacturing Company, Limited, and of the Hamilton Cataract Power Company. In 1878 the deceased gentleman married Miss Margaret Wilde, of Hamilton, Ont. He is survived by his widow and six children.

To the world outside the Bell Telephone Company's offices Mr. Sclater was perhaps best known as one of the chief exponents of the gospel of outdoor life. He was one of the best all-round athletes in Montreal. Between 1870 and 1875 he was well known in sporting circles in England, rowing at Henley in the Kingston crews of 1874, 1875 and 1876, and during the same period played on South of England football teams. When in America he rowed stroke in a South Caroline rowing club four which was victorious in the Charleston regatta of 1877. For two years he was president of the St. George's Snowshoe Club of Montreal.

One of his fellow-officers, in speaking of Mr. Sclater, said that of all the features of his finely-rounded character, perhaps a love of justice was the most pronounced. His was eminently a judicial mind, coupled with a strong sense of duty, and strengthened by unflinching courage. The consequence was that all men with whom he came in contact felt convinced of his desire to view a subject from every side, and to have his judgment on the result of such examination rather than upon any pronounced opinions. Naturally, with a reputation of such a character, he was both respected and trusted by his employers and fellow-officers, and has left behind him, in the offices of the company, the memory of a man of conscientious devotion to duty, of kindly nature, and of high professional abilities.

SHORT CIRCUITS.

At a special meeting of the directors of the New Brunswick Telephone Company, held at Fredericton on March 29th, Hon. F. P. Thompson, who has been acting as managing director, was elected president to succeed Dr. Stockton. Mr. Alfred Seely, of St. John, was appointed secretary-treasurer in place of Mr. W. E. Smith, resigned, while Mr. F. V. Carvell, M.P., of Woodstock, was appointed on the board to fill the vacancy caused by Dr. Stockton's death.

The Municipal Council of Miniota, Man., have decided to take up the question of establishing a telephone system throughout the municipality. Expert Francis Dagger estimates that about 275 miles of pole line will be required to cover the municipality.

Premier Roblin, of Manitoba, states that 1,000 miles of telephone lines will be built in that province immediately. Contracts have already been closed for poles, and other material is being looked for, so that the construction can be proceeded with.

Hon. Mr. Davis has moved the following resolution in the Dominion Parliament: "That in the public interest the Government should appoint an expert officer in connection with the Board of Railway Commissioners of Canada, to be called a Telephone and Telegraph Commissioner, whose duties shall be to have full control, as regards construction, location, maintenance and operation of all telegraph and telephone lines in Canada."

The Toronto & Hamilton Radial Electric Railway Company are asking the Dominion Government for power to build, in addition to their present main line from Oakville to Toronto, branch lines from Hamilton to the Niagara river, and from Brantford to the Detroit river, running through Brant, Elgin, Kent and Essex, and through or near Woodstock, St. Thomas and Chatham.

Allis-Chalmers-Bullock, Limited, of Montreal, have moved their Winnipeg branch offices from the Canada Life Block to more extensive quarters at 251 Notre Dame avenue. These new offices are well lighted, well equipped, and in every way suitable for show rooms. A large stock of motors are now on their way from Montreal. As previously reported, Mr. R. H. Zavitz, late manager of the Vancouver branch, has taken over the managership of the Winnipeg office, assisted by Mr. W. E. Murphy, district engineer, and Mr. F. W. Burnham. Mr. Zavitz reports that business is brisk and that a large number of small motors are being sold in Winnipeg.

Electric Railway Department

REPORT ON STREET RAILWAY FENDERS.

The Ontario Railway and Municipal Board, upon the application of the Toronto Railway Company, recently appointed Messrs. J. F. H. Wyse and H. W. Middlemist, consulting engineers, Toronto, to conduct tests of street railway fenders. A number of different devices were tested, with the result that the Jenkins automatic fender was recommended for use on the cars of the Toronto Railway Company. The report in part is as follows:—

The number of difficulties incident to obtaining a first-class fender are recognized more readily by those familiar with the operation of street cars and electric railways than by the public itself. Many prohibitive objections are apparent at once to the street railway man, but the dreadful results of these objections and faults are only too apparent to the public in the enormous number of fatalities due to poor fenders and their failure to operate at the exact instant when required. A little boy jumps from behind a waggon, and with the usual lack of consideration shown at his age, starts for the sidewalk, when a car he did not see (and the motorman of which did not see him), grinds into a scarcely recognizable mass what only a few seconds before was perfection of life and happiness.

The list of fatalities where an automatic fender would have saved (and with people of all ages) is appalling as to their number, and the horror and rapidity of their execution.

The short space of time elapsing between the appearance of the victim and the contact of the latter with the car, together with the very natural agitation of the motorman under such circumstances, renders it practically impossible for him to effectively operate a fender.

Ringing the gong, turning on and off the current and applying the brakes are performed so often as to become almost an unconscious mechanical action. Whereas the unusual and rare occasions of dropping a fender necessitates the mental guidance of the motorman for its accomplishment.

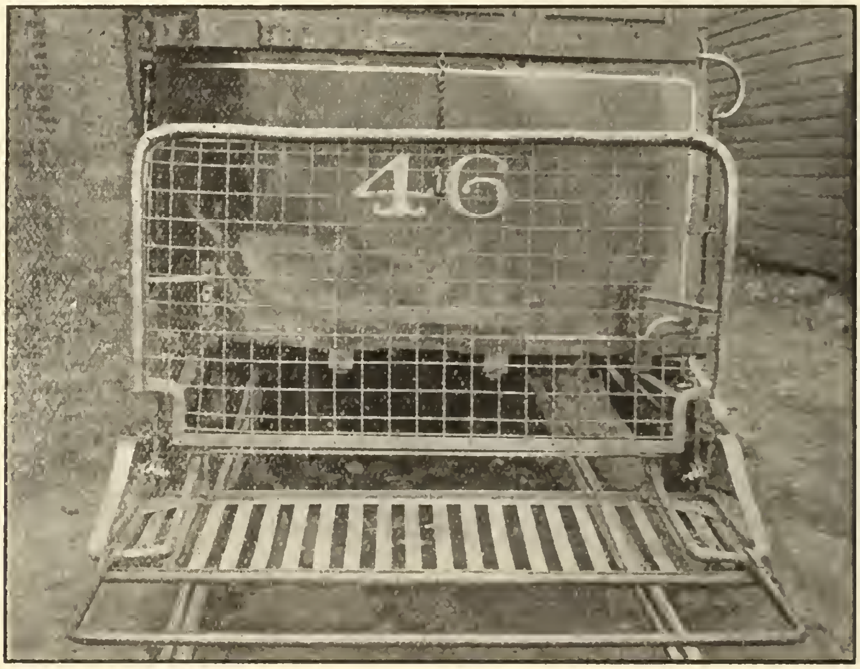
The lack of necessary time for this tripping, and the uncertainty of its effectiveness, makes apparent the demand for an automatic device which must—

First—Be dropped to the paving by coming in contact with the person to be saved.

Second—Be automatically dropped with a minimum impact or slight blow of tripping device so that the fenders may go well under the object without damage to the latter.

Third—This must be done with incredible rapidity. For example, if the car is travelling at the rate of only 10 miles an hour the fender must be dropped from its normal height to the pavement in one-fifteenth of a second in order to pass under the object struck, as at that speed the car travels approximately 15 feet a second. For this reason it will be quite obvious that dropping by gravity at a speed of 10 miles an hour is entirely inadequate.

Fourth—The fender must be held in its position against the friction of the pavement caused by the onward motion of the car and must be of such construction as to pass under the object and not rise and go over it. The inclination to roll away or over the object creates a tendency to force the fender up from the roadbed. And for this reason we recommend that a wheel guard be used in all cases, the latter to be rigidly fastened to the truck of the car and to be not more than two inches above the top of the rail, and in shape to be straight, that is, at right angles to the rail. Said wheel guard to be made either of wood or heavy wire and substantially framed. Samples of wheel guards with necessary fittings to be submitted to your engineers for approval before being adopted. In addition to this the space on either side at the back of the fender and between it and the forward wheels should be protected with a substantial wire screen or other appliance, approved by your engineers, to prevent a body from being turned in behind a fender and in front of the wheels in the event of being struck by the corner of the fender.



The Jenkins Automatic Fender.

Section No. 217, Clause "B," of the Act provides in all cases where the rails are laid upon the paved or travelled portion of the street, or any part thereof, the rails shall be laid (as nearly as practicable) flush with the street, and shall be laid so as to cause the least possible impediment to the ordinary traffic of the street, and shall be so kept and maintained by the railway company. We regret that in Toronto this is not the case, the variation between the height of the rails in many sections of the city, together with the high crossings

and the approach to steep grades, necessitates carrying the fenders at a height of about six inches.

The oscillation of single truck cars necessitates a fender of the best design to be hung on to the truck so as to be practically non-oscillating and minimizing its movement with the movement of the car.

The records of tests of the Twentieth Century fender in the past impresses us with the fact that the working parts of any fender to be adopted should be uniform in location, simple and easily understood by the motorman, so as to be readily kept in perfect condition. In this connection we would strongly recommend that your engineers make a periodical, and, so far as the company is concerned, an unlooked-for inspection of the life-saving equipments of the cars, with power to prosecute any case where fenders are found not to be in good working order. It does not appear clear to us that Clause 211 of the Act sufficiently covers the proper maintenance by companies of approved fenders and their being kept in good working order. We would, therefore, recommend to your honourable board an addition to the Act, "providing a substantial penalty for the carrying of defective fenders, guards, brakes, or other life-saving appliances," as a fender operated and not maintained as approved, is not and should not be regarded in law, as complying with the Act. It also appeals to us that your honourable board should have power, as recommended by your engineers, to recall their approval of fenders, or wheel guards at any time if the said fender or wheel guards should prove inefficient, or when same may be replaced by something decidedly better in design and operation.

Invitations were issued by your engineers to a number of inventors and manufacturers of fenders that on the 27th day of November we would make a public test of same for the purpose of recommending for adoption on cars in the City of Toronto such devices as, in their opinion, best answered the requirements. In answer to our invitations application was made to the street railway by some sixteen inventors for street cars and the necessary appliances for making the test. Without an exception every convenience and assistance to facilitate this was given these inventors by the Street Railway Company to make a most thorough test. The tracks available were on Sherbourne street and Howard Park avenue, of which we chose the latter as being more free from traffic or other interruptions.

The 27th, unfortunately, was wet and unfit for the first test, which was postponed until the 28th, and completed on the 29th. On the 15th and 16th of this month (January) a number submitted by different inventors were also tested, and three or four are yet being prepared for testing. Each one was thoroughly tested until we were able to form an accurate estimate of its value. Among the fenders tested there were several which, while they did not come up to the standard of efficiency considered necessary, contained many unique and ingenious features. And some of these fenders we have no doubt with some improvements and modifications might yet meet the demands for an efficient life-saver. There were also two fenders of the trip variety, namely, the Twentieth Century and the Odell fender, which in that class might be considered to have special merit, but, as we have already indicated, a trip fender on crowded streets like those of the City of Toronto is unsafe, and, in our opinion, should not be permitted to be for a longer period of time than will be fair and reasonable to admit of a change to another design, say about six months. Until this change is made we recommend that the trips of the Twentieth Century fender should be changed as shown on the one tested, i.e., the shorter lever on the platform dropping the fender, the longer one to be used only for resetting same, and that these trips should be uniformly located conveniently to the motorman about the centre of the platform, and not as now on some cars in the centre and on others at the extreme edge, and that these fenders be kept in proper working order with their locks on and operative.

We recommend that these changes be made within sixty days after date of notification from your board, that said changes are necessary, and, further, that your board instruct your engineers to take steps, such as are necessary, to insure that your instructions in this respect are being complied with.

Under all the circumstances, and having regard to the whole situation, we feel that at the present time there is only one fender among those which we have tested up to date which seems to fill the requirements of a life-saving device for the front of electric cars in the City of Toronto, namely, the fender manufactured by the Jenkins Automatic Fender Company, of Toronto, and we therefore beg to recommend the same to your honourable board for adoption. We further recommend that the Toronto Street Railway should discard all other fenders and equip their cars with the Jenkins Automatic fender within six months from the date of this report.

We beg to express the opinion, however, that certain improvements will be made in several of the fenders which have been tested, and before very long we may be in a position to recommend for your approval at least two or more automatic fenders.

We recommend for your consideration for adoption a gong to be rung under the rear platform of all cars when backing or wying. This to be substantially a part of the device as shown by Mr. A. D. Bentley and by us on the 29th of November, and again on the 16th of January.

It should be a gong sufficiently loud, and operated electrically or otherwise controlled from the front platform by the motorman and subject to the approval of your engineer.

We recommend that cars slow down to at least three miles an hour on approaching other cars that are letting off passengers. A large percentage of accidents are caused by passengers stepping from behind a standing car immediately in front of one moving in the opposite direction. For this reason on some roads cars slack up on meeting, others stop to let off passengers, and on other roads the approaching car comes to a full stop before passing the stationary car. All of which is respectfully submitted.

J. F. H. Wyse.
H. W. Middlemist,
Engineers.

Construction of the Jenkins Fender.

The cradle or horizontal portion of the Jenkins fender upon which the bodies are picked up, is a steel frame, covered with light steel bands, and is held in place by two steel gravity supports. On each side of the cradle is a flat steel spring, with a heavy downward strain. Connected with the above support a safety guard extends out about sixteen inches in front of and on a level with the front of the cradle as a feeler, and when the car approaches an object on the track the above mentioned guard is the first to come in contact with it, and is pushed back freely towards the fender, releasing the two steel supports, when the springs at once force the fender to the road before it reaches the object struck.

The above mentioned springs force the cradle to the ground, hold it there, and, while the pressure is sufficient to prevent anything getting beneath, the fender is not so locked as to break when it comes in contact with rough or uneven ground.

In addition to the fender being automatic, it can be operated by the hand, foot or knee. The cushion, or that part of the fender which stands up in front of the dash-board, is made of woven steel wire, with about a three-inch mesh, which, if the opportunity presents itself, a person may grip. The steel frame is covered with a rubber cushion, as is also the front bar of the cradle.

The fender can be raised or lowered to meet the requirements of different roadbeds, or of snowstorms, etc.

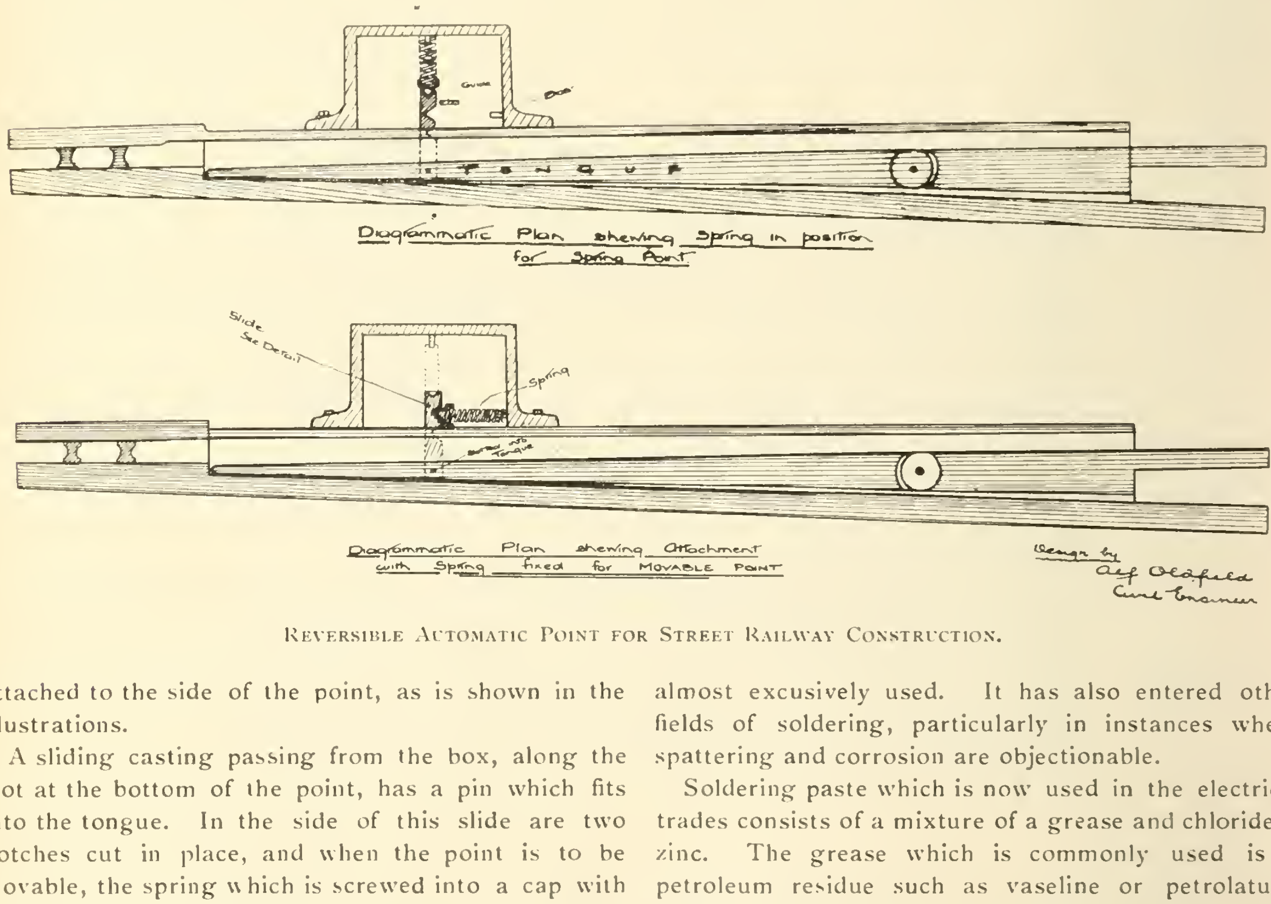
On single truck cars, the fender is attached to the truck by means of flat steel arms, with a spring near the front, connecting them with the body of the car to relieve a portion of the weight of the fender, and with a guide to keep the fender always in place in front of the car. This prevents the fender following the motion of the body of the car up and down, and keeps it always at a uniform distance from the track.

REVERSIBLE AUTOMATIC POINT FOR STREET RAILWAY CONSTRUCTION.

By the courtesy of Mr. A. Oldfield, C.E., the general manager of A. Oldfield & Company, consulting civil engineers, Kennedy Building, Winnipeg, we are able to describe the new street railway point designed by him. This point was intended to overcome the deficiencies of the ordinary movable point.

Mr. Oldfield has had a large experience in street railway construction both in England and Canada, and he has invariably found that the tongue of a movable point works loose after very little use. The consequence, as we daily see, is a tendency to throw the back truck of a car on to the wrong track, this being caused by the vibration of the tongue when the fore truck is passing over it.

The whole of this new attachment, which is for either a spring or a movable point, is enclosed in a box attached to the side of the point, as is shown in the illustrations.



Reversible Automatic Point for Street Railway Construction.

A sliding casting passing from the box, along the slot at the bottom of the point, has a pin which fits into the tongue. In the side of this slide are two notches cut in place, and when the point is to be movable, the spring which is screwed into a cap with conical projection is placed in position. The spring holds the tongue on either side, and yet does not prevent being easily thrown over.

Mr. Oldfield was until recently engineer for the Winnipeg Electric Railway Company, who have adopted this attachment, which they think fills a great necessity.

BURYING RAILWAY TIES IN CONCRETE.

Mr. C. H. Rust, City Engineer of Toronto, writes to the Engineering News as follows: "In your issue of Jan. 17 I notice your comment upon the practice of burying wood in concrete in street railway track construction. In 1892, when the present Toronto Street Ry. Co. converted the old horse car line into an electric line, the city in connection therewith constructed a permanent pavement, the railway company putting down the wooden ties and rails. The ties were supposed to be placed on a bed of sand and gravel 3 or 4 ins. deep, but in some cases they were put upon natural soil; concrete was then placed around the ties, but none under them. Upon frequent occasions we have examined these ties and none have been subject to dry rot. In most cases the ties were full of moisture and in sound condition. The ties were cedar. We, have, however, since abandoned this form of construction and now lay the rails on a concrete beam 12 ins. deep and use steel tie-bars spaced about 6 ft. apart."

SOLDERING PASTE.

Soldering paste has come into extensive use in electrical work as a flux for soldering, says the "Brass World." This has been brought about by the requirements of the electrical trade that in certain forms of soldering no acid shall be used. For soldering copper wires for electrical conductors, soldering paste is almost excusively used. It has also entered other fields of soldering, particularly in instances where spattering and corrosion are objectionable.

Soldering paste which is now used in the electrical trades consists of a mixture of a grease and chloride of zinc. The grease which is commonly used is a petroleum residue such as vaseline or petrolatum. Such a material is about right in consistency. The proportions which are used are as follows:

Petrolatum .... 1 lb.
Saturate Solution Chloride of Zinc 1 fluid oz.

The use of petrolatum instead of vaseline is recommended. While they are identical in composition, the name "vaseline" is registered as a trade-mark and commands a higher price on this account. Petrolatum is much cheaper.

Measurement of coal consumption is made by a novel method at the new Port Morris power station of the Electric Zone of the New York Central R. R. The down spouts from the coal storage bunkers to the stoker hoppers are fitted with shut-off gates at either end, the capacity of the spouts between gates being 1,000 lbs. The handle of the lower gate is connected to a serial counter, and the procedure is, after filling the downspout by the upper gate and then closing, to open the lower gate, by which 1,000 lb. is delivered to the stoker. The counter automatically records the number of such deliveries and the coal consumed with a fair degree of accuracy.

THE ILLUMINATION OF BUILDINGS.

At a meeting of the Manitoba Association of Architects, held on March 27th, Mr. E. C. White, formerly of New York, delivered a lecture on "The Electrical Illumination of Buildings."

In introducing his subject, Mr. White said that the arrangement of lights had become a science, as well as an art. Illuminating engineering was a new profession, hardly more than a year old. In February, 1906, an illuminating engineer's society was established in New York, and since then branches had been established in Chicago, Philadelphia, Boston and Pittsburg. The work was distinct from that of the architect or the electrical engineer, and had as much to do with physiology as with mechanics, inasmuch as the results produced could only be judged by the visual effect.

The custom of laying out electric lighting by the cubic foot was now obsolete, things were now judged by result. It is not only necessary to produce sufficient light, but to place that light in such a manner as to insure a proper visual effect.

Since the development of electric lighting, much attention has been paid to the efficient generation of current, and also to the efficiency of lamps of all kinds. The light, however, has been carelessly used, practically no attempt having been made to direct the rays in useful directions. To accomplish this thoroughly and in such a way as to produce the required illumination for specific purposes, together with the avoidance of such arrangements as are injurious to the eyesight, are the main objects of the illuminating engineer.

The human eye, continued Mr. White, is educated by daylight conditions, the eyebrows shade the eye at an angle of 20 degrees, and this fact must be borne in mind before a building is wired. As it is essential, in order to preserve the eyesight, to reduce the intrinsic brilliancy, the proper shading of globes is a matter of much importance, but this shading must be done in such a manner as to produce the maximum amount of light. The speaker condemned ceiling illumination, especially in lofty rooms, which, he said, was wasteful. The lighting of comparatively small buildings with arc lamps, he said, was a very bad practise.

A common method of reducing brilliancy was the use of the frosted lamp. Experiment has shown that the life of a frosted lamp is 45 per cent. less than that of a clear lamp; whether this fact was known or not, he was not prepared to say, but he did not think that it was fully appreciated. The life of a clear lamp placed within a frosted globe was only slightly reduced.

A common belief among the uninitiated was that to cause the illuminating rays to spread at a wide angle it was necessary to use a practically flat shade. This was an entirely erroneous theory. The rays have to be diffused.

Mr. White then gave a practical illustration of this fact, exhibiting two glass shades seven inches and four inches respectively. He showed that the illuminating rays were thrown in a more horizontal direction by use of the deeper shade than by use of the shallow one.

The question of color, said Mr. White, was more a matter for the architect, but it was important to remember that a more powerful reflection was thrown from one colored wall than another.

A practical demonstration was then given of the use of the Nernst burner.

In conclusion, Mr. White said that he felt that fixture-making to-day is not very much further ahead as an art than furniture-making was when William Morris started in to teach people how to make comfortable as well as beautiful furniture, and he thought that within another ten years, instead of having mere ornaments on which lighting fixtures are to be hung, we should have fixtures that in themselves would provide for the specific requirements of a building.

APPROVAL OF THE CONMEE ACT.

The much-abused Conmee Act has received the approval of the Ontario Railway and Municipal Board, which last month reported against its repeal. The report in part is as follows:

Section 9 of bill 151 provides for the repeal of paragraphs A, A2, A3, A4 and A5 of sub-section 4 of section 563 of the Municipal Act. These paragraphs are known as the Conmee clauses of the Municipal Act.

In looking at the reports of the debates in March, 1899, when the Conmee clauses were passed, it is clear that they were intended to prevent what would, in many cases, amount to the confiscation of private rights, by permitting the municipalities to construct gas, electric light or water works in the municipalities where a company had constructed and were operating similar works.

Several companies are operating either gas, electric light, or waterworks in municipalities in the Province of Ontario. Many of these public utilities were installed before 1899, and, we believe, a few since the passing of these clauses. The most of them were built at a time when they would not pay dividends to the promoters. The municipalities were alive to this fact, and in many cases used all their influence and held out inducements to the companies to instal these conveniences.

Many municipalities would not embark on these enterprises because they would not pay, but were perfectly satisfied to permit a company to do so and to operate them in the lean years, but as soon as they commence to be remunerative the municipalities became anxious to get into the business themselves.

The Conmee clauses were designed to prevent the duplication of gas, electric light or waterworks, and thereby the ruin of the companies who had embarked their money in installing these utilities. The Board are aware that in several instances these clauses have effected this purpose and prevented a serious loss of invested capital.

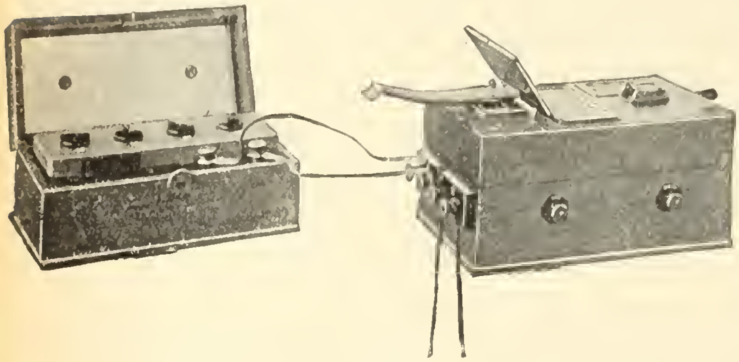
The Board cannot see any good reason at present for repealing these clauses. There are no obstacles in the way of municipal ownership; they are only a barrier to prevent the application of the companies.

The Packard Electric Company, Limited, recently secured an order from The T. Eaton Company, Limited, for 250 Jandus enclosed arc lamps. The Eaton Company have now about 600 of these lamps lighting their large stores in Winnipeg and Toronto.

MODERN TESTING INSTRUMENTS.

The old-established firm of Evershed & Vignoles, Limited, London, England, have recently opened a Canadian office at No. 3 Dineen Building, Toronto, their representative being Mr. J. F. B. Vandeleur. Here they are carrying in stock a complete line of their well-known electrical testing and moving coil instruments, including their latest specialty, the Patent Bridge Megger, which was placed on the market only a few months ago. Some particulars of this device will be interesting to Canadian electricians.

The Bridge-Megger as its name implies, is an instrument which combines the functions of a Megger with those of a Wheatstone bridge. As a megger, it is used for determining



PATENT BRIDGE MEGGER AND RESISTANCE BOX.

by direct deflection on the dial any resistance between 0 and 40 megohms, the first division representing 5,000 ohms. The generator is of the constant volts type, and is provided with two windings, which for megger measurements are coupled in series and give 500 volts.

Externally, and so far as the user is concerned, the megger is simply a substantial teak box with a window in the top through which the ohmmeter dial is seen. The generator winch handle is at one end of the box. On the side of the box are two terminals clearly marked line and earth. To test the insulation of a circuit it is only necessary to set the megger down on a fairly level base, connect the circuit wires to the line and earth terminals and give the winch handle half a dozen rapid turns. The ohmmeter is aperiodic and the index promptly comes to rest and points to the insulation resistance in a second or so from the start. There are no switches, no plugs, no adjustments, no key to be tapped, no galvanometer to watch, no rheostat to adjust. There is no multiplying or dividing by ten or by a hundred; the scale is always read directly without any calculation whatever, and the ohmmeter index comes to rest at a point where the value of the insulation resistance is plainly written in so many hundred thousand ohms. or so many megohms.

Inside the megger box are a hand dynamo and an ohmmeter. The ohmmeter is dead-beat, moving-coil instrument, with a current-coil moving in a powerful magnetic field, and an astatic pressure coil controlled by the same field. The range of the instrument reaches 2,000 megohms. The coils are carried upon an axle fitted at each end with a large and very strong pivot working in a sapphire bearing, yet notwithstanding the size of these bearings the movement is without a trace of friction. A greatly improved scale enables the readings to be extended down to zero without the use of a shunt and its attendant switch. The scale, being approximately logarithmic, can be read to a nearly equal degree of accuracy throughout the greater part of the range. A view of the Bridge Megger and Resistance Box is shown herewith.

Other instruments manufactured by Evershed & Vignoles include the cell tester, adapted for measurements of voltage on primary and secondary batteries; portable moving coil ammeters and voltmeters, for general measurements up to 1,000 volts and 1,000 amperes; portable gauges and electric stoking indicators. They make a special form of marine adjustment for use in instruments on shipboard as supplied to the British Admiralty, also gunnery telegraphs and turret danger signals.

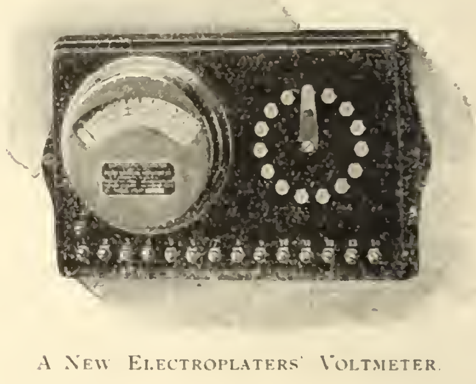
Mr. Vandeleur advises us that goods will be shipped from England in zinc-lined heavy wooden cases, and that prompt delivery is guaranteed. He will carry in stock a supply of spare parts against each order, so that customers will be able to obtain same without delay. He invites the electrical fraternity to give him a call and to write for his new Canadian catalogue.

A NEW ELECTROPLATERS' VOLTMETER.

The accompanying illustration shows the model 131 electroplaters' voltmeter placed on the market by the Weston Electrical Instrument Company, Waverly Park, Newark, N. J. In plating establishments the voltmeter is an important piece of apparatus, as upon its reliability the quality of the work depends. The amount of current consumed in a bath is governed by the quantity of work being done, and the current flowing is, of course, dependent upon the voltage. Too much current results in burned work, while too little current results in a thin deposit which comes off under the buffing wheel, necessitating replating.

Owing to the apparently high first cost of furnishing each tank with a reliable and accurate voltmeter, platers have hesitated to properly equip their plants, using unreliable instruments or doing without instruments of any kind. Realizing the importance of first cost from the plater's standpoint, the Weston Electrical Instrument Company has designed this voltmeter, which is especially adapted to this work, obviating the necessity of having an instrument for each tank, and enabling the plater to avail himself of an extremely accurate and reliable instrument at a low cost.

The instrument consists of an accurately calibrated Weston voltmeter contained in an air-tight, waterproof case, which adequately protects the internal mechanism from the action of fumes usually present in a plating room, and mounted on a small wooden switchboard containing fifteen binding posts and a fourteen-point switch. One of the binding posts, marked "plus," is attached to the positive side of the plating generator or line, while the remaining posts are to be attached one each to the cathode side of each tank. After the connections are made the voltmeter is thrown in circuit with any desired



A NEW ELECTROPLATERS' VOLTMETER.

tank by turning the switch handle to the tank it is desired to test. The instrument is designed to accommodate fourteen tanks, which is considered the maximum number that can be conveniently operated from one point.

Mr. C. T. Wilkinson, manager of the electric light and waterworks plant at Brockville, Ont., has recommended that additional apparatus be installed, and that the electric light and waterworks plant be operated conjointly, thus effecting a saving in operation.

The Vancouver, Victoria & Eastern Railway may, when completed, be electrified from the mountains to the Pacific coast. It is understood that the Great Northern Railway is behind the Stave Lake Power Company, and by those following the most recent developments in railway building it is regarded as altogether probable that electricity will be substituted for steam.

The Lakefield Portland Cement Company, of Lakefield, Ont., are building a branch factory in Montreal, which will be electrically equipped. The Canadian General Electric Company have secured the contract for three 1,300 horse-power transformers, two 2,000 horse-power transformers, one 20 horse-power motor, twelve 100 horse-power motors, and three 10 horse-power motors, complete with switchboard and speed controllers.

BENJAMIN OUTLET-BOX RECEPTACLE.

The Benjamin Electric Manufacturing Company, of 64 York street, Toronto, are placing upon the market a new No. 6-B receptacle specially designed for use with outlet boxes. This receptacle has a number of strong, attractive features, mentioned as follows:—

"Its contacts do not project beyond the walls of the receptacle, and therefore do not readily come in contact with the metal parts of the box or projecting parts of the conduit. Wires are easily spread around the base, thus making slack

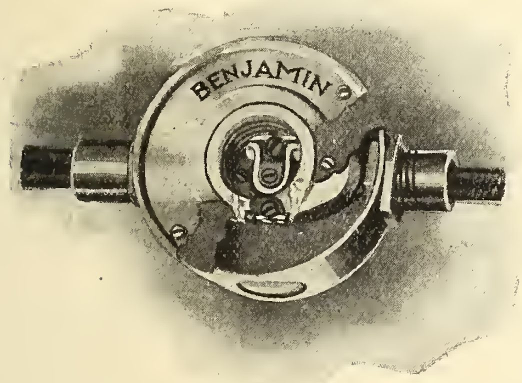


FIG. 1.—BENJAMIN OUTLET-BOX RECEPTACLE.

wire unnecessary. Binding screws are accessible from the front, obviating the necessity of reversing the receptacle or of tapping wires to make connections. It may be connected while in position in the box, the cover being attached after connections have been made.

"The receptacle is herewith illustrated, Figs. 1 and 2 showing it mounted and unmounted.

"A steel-plate cover (Fig. 3) is furnished, through which

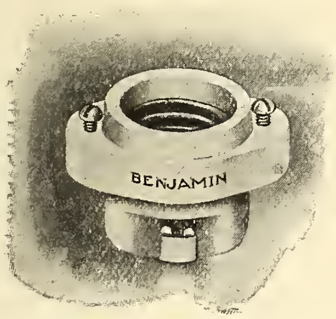


FIG. 2.—BENJAMIN RECEPTACLE UNMOUNTED.

the porcelain receptacle slightly projects. Over this a polished brass cover (Fig. 4) may be used with or without shade holder. Where a shade holder is desired it is spun upon the brass plate, forming a neat and substantial device (Fig. 5).

"A special point of interest attaches to these receptacles in connection with their contemplated use in the Port Huron tunnel of the Grand Trunk Railroad. The accompanying cut (Fig. 6) shows a vertical cross-section of the box to be used. It is of cast iron, with threaded outlets to receive the conduit, thus securing a water-tight joint. A rubber gasket extending from the outer edge to the centre opening, through which the socket projects, is placed under the steel-plate cover. Both the outer edge and the socket are thus protected against moisture. If found necessary, a vapor-tight globe will be screwed against the rubber gasket. If no globe is used, as will probably be the case with so tight a box, a rubber lamp ring will be substituted. Globe holders of sheet aluminum will be supplied.

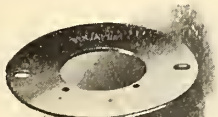


FIG. 3.—BENJAMIN RECEPTACLE.

"Where it is deemed desirable to use a guard, provision is made for attaching it directly to the holder.

"Complete protection for any or all conditions is afforded by this serviceable device."

TRADE NOTES.

The capital stock of the Conduits Limited, Toronto, has been increased from $40,000 to $100,000.

A new company has been incorporated in Toronto under the name of Electrical Specialties, Limited, to carry on the business of electricians, mechanical engineers and manufacturers. The provisional directors of the company are Messrs. A. C. McMaster, G. R. Geary and F. D. Byers.

The Packard Electric Company, Limited, recently secured an order for three 300 k.w. 12,000 volt transformers from the

FIG. 4.—BENJAMIN RECEPTACLE.

Ontario Power Company, to be installed at the Government elevator at Port Colborne, Ont., also three 200 k.w. 12,000 volt transformers from the Ontario Iron & Steel Company for their works at Welland, Ont.

A company has been formed, known as D. K. McLaren, Limited, to acquire and continue the business carried on by D. K. McLaren, dealer in leather belting, mill supplies, etc.,

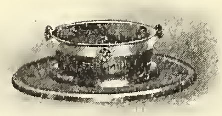


FIG. 5.—BENJAMIN RECEPTACLE.

Montreal. The capital stock of the new company is $250,000, the incorporators including Messrs. D. K. McLaren, W. F. McLaren and R. M. W. McLaren.

Recent sales of Crocker-Wheeler apparatus through The Packard Electric Company, Limited, include one 50 k.w. a.c. belt type generator, one 100 d.c. belt type generator, one 100 k.w. d.c. engine type generator, one 150 k.w. d.c. engine type

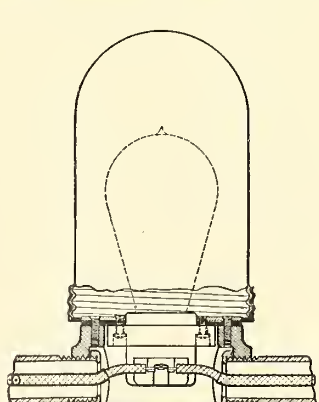


FIG. 6.—BENJAMIN RECEPTACLE.

generator, one 45 h.p. d.c. motor, one 26 h.p. d.c. motor, one 100 h.p. 60 cycle induction motor, and one 150 h.p. 60 cycle induction motor.

Allis-Chalmers-Bullock, Limited, have recently made the following installations: Lighting plants for High River, McLeod and Welburn; extra 260 k.w. generator for Calgary; power plant for P. Burns & Company, Calgary; motors at new mill at Fort Rouge for Mr. J. Arbuthnot, whose mill was recently destroyed by fire; 30 h.p. motor for Kelly Bros. & Mitchell, contractors, Winnipeg.

A BRIEF AGAINST MUNICIPAL OWNERSHIP.

The question of municipal ownership has now reached such a stage as to call for a closer and more definite examination than has yet been had of the asserted advantages of the policy and of its ascertained results where it has been applied. The results of the agitation of the subject as regards the railways in Chicago and the closeness of the vote in the New York City election of 1905, where one of the candidates stood on a municipal ownership platform, have demonstrated that the question is an actual one, while the statistics of the growth of the burden of local debt in recent years demonstrate its importance to the taxpayer. Fresh interest has been lent to the subject recently by the statements coming from London regarding depreciations in the stocks of municipalities which have adopted the policy of public ownership, owing to the extent of their borrowings; by the complaints made in the French capital of the expense and inefficiency of the Government telephone service, and, finally, by the overthrow in the London County Council elections of the municipal ownership regime, which has been in control for eighteen years.

It will be recalled that the National Civic Federation some time ago appointed a committee to investigate and report upon the actual results of public ownership and operation so far as they have been undertaken in the United States, and of the more extensive practice along those lines in foreign countries The constitution of this committee gives ground for the expectation that its report will be the most important contribution to general information upon the subject that has yet been made. Pending its appearance, however, those interested in the subject, and they, we imagine, comprise a large and growing class, will not neglect other contributions of interest. One of these which has recently made its appearance is the volume on "Dangers of Municipal Ownership," by Mr. Robert P. Porter, well known as the director of the eleventh United States census.

The title of the volume sufficiently indicates that the writer has already made up his mind upon the question, or, at any rate, upon some phases of the question. Indeed, in his preface he declares that the object of the book is to set forth "the inherent defects of the whole principle of public trading." In the main, the instances upon which the writer bases his unfavorable conclusions respecting municipal ownership are taken from the experience of municipalities in the United Kingdom, but he discusses also the history and results of municipal and state ownership in Russia and Australasia, and compares the results of telephone operation by the state or by municipalities in various European countries with that of the condition of the service under private operation in the United States. The author has made a timely and interesting contribution to the discussion of a subject which has grown in importance in the United States of late years. His marshaling of the evidence gathered by him is forceful, and in the present state of the question the volume cannot be neglected by students of the municipal ownership problem.

The Nipissing Telephone Company, Limited, has been authorized to increase its capital stock from $5,000 to $50,000.

TEST OF TURBINE GENERATOR.

A test run of an Allis-Chalmers hydraulic turbine generator unit was recently conducted at the city power plant of Nelson, B.C., in the presence of city officials, which resulted decidedly in favor of the apparatus. The turbine generator unit has a normal capacity of 750 k.w., but during the test run this output was increased to 1,340 k.w. for a period of over 45 minutes' continuous running without undue increase in temperature of bearings.

The usual tests were made as to the heating of the coils and bearings. According to the guarantees the armature and field coils did not rise in temperature above 35 degrees centigrade.

The supply for light and power has been furnished up to the present time by the West Kootenay Power & Light Company, situated just across the Kootenay river from the new city plant, out of which source both companies derive their power.

The hydraulic turbine, which is of standard design, was built at the Scranton, Pa., works of the Allis-Chalmers Company, and the generator, which is the vertical type, specially designed for direct connection to hydraulic turbines, was built at the works of the Allis-Chalmers Company, Cincinnati, Ohio.

A CLEVER ELECTRICIAN?

"Yes, we get some funny stuff now and again," said the Electrical Inspector in Toronto. "Just a few moments ago my telephone announced Mr. ———, who was on the verge of an apopletic fit about his electric wires.

"'My nephew, a good electrician,' said he, 'informs me that the wiring in my house is very defective and liable to burn us out or kill us,' was the alarming news that greeted my ears.

"'Indeed! Why your house wiring was done by L. A. R. Brown & Company, one of the best firms in the city, and was all passed in due time; what's the trouble?' I asked.

"'Why, the man has run a pipe down outside my house from the overhead wires to the meter in the basement.'

"'Yes, that's right,' said I.

"'Yes, said Mr. ——— mysteriously, 'but do you know he has connected this electric conduit to the water pipe with a piece of copper wire?'

"'Yes, that's perfectly correct.'

"'But my nephew says that if one should touch the kitchen tap during a thunderstorm the lightning will run off the water pipe and kill them.'

"'Well, well, I never knew that before; the National code has always called for a ground wire on conduits, and so have all electrical engineers.'

"'But my nephew says that it is wrong,' pursued Mr. ———.

"'We will then be obliged to change the code,' and Mr. ——— is now wondering why the National Electrical Association did not consult his nephew before compiling it."

The enlargement to the lighting plant of the Town of Barrie, commenced last May, has been completed, and the new equipment is now running in service. Mr. K. L. Aitken, the consulting engineer, of Toronto, made an extensive series of tests during the week of March 11th, and all the apparatus has since been accepted.

COMPOUND-WOUND MOTOR-GENERATORS.

By R. S. Wallace.

The Peoria (Ill.) Gas & Electric Company, several years ago, when enlarging its station, found it desirable to unify its generating machinery so as to have all generating units three-phase, alternating current. In making this change, there was a considerable 500-volt direct current power business which had to be taken care of, and this was done through motor-generator sets consisting of three-phase, synchronous motors, driving 500-volt direct-current generators. The motors, which had previously been used as generators, were of the revolving armature type and each of 150 kw. capacity.

Many elevators were supplied from the 500-volt direct-current service, and the rapid fluctuations in load on the motor-generators caused considerable variation in the three-phase bus voltage from which the lighting service is supplied. In order to prevent this, a series winding was placed on the fields of the synchronous motors. The winding was connected in series with the direct-current generator, so that the current delivered by the generator flowed around the motor field, over-exciting it and inducing a leading current in the motor armature, proportional to the load on the direct-current generator, and which reacted on the three-phase generators, thus maintaining a constant voltage on the three-phase bus-bars regardless of the load carried by the direct-current generators.

The number of turns and the current required for this series winding were determined by manipulating the field rheostat of the synchronous motor, and observing the increase of motor field current necessary to maintain the three-phase bus voltage constant while the load on the motor increased from zero to full load. The number of turns in the shunt-field winding of the motor being known, the ampere-turns necessary to produce the desired result were easily determined and the series winding was proportioned accordingly. On account of there being insufficient space between pole pieces on the motor for a conductor large enough to carry the full-load current of the direct-current generator, a larger number of turns of a smaller conductor were wound on each of the poles and a shunt placed across the terminals of the entire series winding as is customary practice with the compound field winding of a direct-current generator.

It was determined by experiment with the motor rheostat, that each motor would require 18,000 ampere-turns to produce the desired results, and as the motor had 12 poles, each was given 10 turns and the shunt proportioned to give the series field winding 150 amperes with full load on the direct-current generator. Slight changes in the shunt, after the machine was put into operatien, gave the result sought for without difficulty. As these motor-generators are usually started from the direct-current end, this motor field winding was connected in the same lead as the series winding on the direct-current generator field, and the starting current applied through the equalizer, the equalizer bus being on the switchboard; the series windings on both motor and generator being thus left out of circuit in starting, they have no naturalizing effect on either field.

Since this arrangement was adopted, a storage battery has been installed, which lessens the fluctuations in direct current load on the generators, and a Tirrel regulator controls the three phase voltage. It is, therefore, not so essential to good regulation as formerly, but when first installed it was of very grea assistance.—Electrical World.

It is understood that extensive improvements are to be made this year to the Galt, Preston & Hespeler and the Preston & Berlin Electric Railways. Additional machinery, to the value of $50,000, will be installed and the line double tracked from Preston to Galt. The total expenditure may exceed $100,000.

The Railway Commission has given judgment directing the Ottawa Electric Railway Company to widen the Somerset street bridge, the City of Ottawa to pay one-quarter of the cost. There is a long history to the case. The bridge in question is where the street railway goes over the steam railways on Somerset street, near the city limits, and the narrowness of the structure has for a long time been commented on. Its dangerous character has been emphasized more particularly since the increase in the volume of traffic on the Britannia line. The City Council initiated the matter and made application to the Commission for an order directing the different railways to widen the bridge, at the same time expressing a willingness to bear a share itself. The steam railways, under the terms of agreements with the street railway, claimed exemption, and it seems that by the terms of the order the Ottawa Electric Railway, principally, and the city will have to bear the cost.

SPARKS.

The ratepayers of Deseronto, Ont., have carried a by-law to provide funds for the installation of an electric light plant.

The Ontario Railway and Municipal Board recently discussed with the City Council of Woodstock, Ont., the proposed improvements to the municipal electric light plant.

The City Council of St. Thomas, Ont., will install an ammonia plant in connection with the municipal lighting system.

After trying for two years to get an acceptable franchise from the Town Council of Leamington, Ont., the Windsor, Essex & Lake Shore Electric Railway Company have bought a private right of way, and will deflect the road to the north side of the town.

The Alberta Power, Light & Supply Company has been reorganized to install an electric light plant at Vermillion, Alta. The officers are: Honorary president, Duncan Marshall; president, H. W. Hopkins; vice-president, H. Bowtell; secretary-treasurer, Walter Gibson.

A financial syndicate is said to be seeking control of the St. John Railway Company, which operates the street railway as well as the electric lighting business of St. John, N.B. Sir William Van Horne and Mr. James Ross are interested in the St. John Railway Company.

American capitailsts, including Dr. Lyons, of Boston, and Dr. Mile, of Rumford Falls, Me., have been looking over the ground with a view to constructing an electric railway at Moncton, N.B., and to connect with Humphrey's Mills, Sunny Brae and the new Intercolonial Railway shops.

The Silver Bell Electric Railway Company, capital $1,500,000, is seeking incorporation from the Dominion Government, to construct an electric railway from New Liskeard down the lake shore to Haileybury, with several branch lines. North Bay and Haileybury parties are behind the project.

The Electrical Committee of the Ottawa City Council have recommended that Mr. William Kennedy, of Montreal, and Mr. Alex. MacDougall, of Ottawa, be engaged to prepare a report on the water powers available adjacent to Ottawa, the probable cost of developing them, the cost of transmission, etc.

A LARGE WATER-WHEEL.

Engineers and sightseers in Troy, N. Y., are much interested in what is called the biggest water-wheel in the world. It is sixty-six feet in diameter and twenty-two feet wide. The monster has thirty-six buckets, each big enough to hold a barrel of Scotch highballs. They call it the Burden wheel, and was a long time coming to a finish. Work was begun on the wheel away back in 1849. The wheel was a success from the start, and ran almost continuously until about ten years ago, when the shop in which it turned the machinery was abandoned. The wheel to-day stands just as it was originally built, with the exception of a few repairs of no great importance. The big wheel made two and a half turns a minute and drove the entire plant of the Burden manufactory, which turned out things of a mechanical character famous the world over. Burden is chiefly known as the inventor of a horseshoe machine. Some time ago it was proposed to demolish the wheel, and work was actually commenced, but there were many protests, and an effort is now making to have the wheel preserved as a monument to the builder who, as an inventor, won national fame.—N. Y. Herald.

SPARKS.

The Stark Electric Power & Light Company are negotiating for a franchise in Weston, Ont.

Mr. P. Paul, jr., Montreal, has been granted a patent for a gas generator, and Mr. J. T. Ellis, Toronto, for a smoke consumer.

The British Columbia Electric Railway Company are now having estimates made on the proposed tram line to Chilliwack. The figures will be submitted to the directors at London.

Messrs. V. J. Hughes, Harold Rolph, Arnold Wainwright, O. Cousineau and C. F. Larkin, all of Montreal, have been incorporated under the name of Metcalf Engineering, Limited, with a capital of $25,000, to carry on the business of civil, mechanical and electrical engineers.

The corporation of Prince Albert, Sask., have accepted the following tenders for electric plant: Boilers, Canada Foundry Company, Toronto, $2,632; engines, Goldie & McCulloch Company, Galt, $14,520; dynamos, etc., Allis-Chalmers-Bullock, Montreal, $9,085.

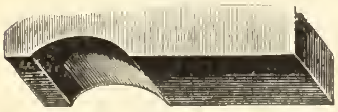
F. A. Cambridge, City Electrician of Winnipeg, has recommended that a competent electrician be employed for the re-inspection of electric wiring in the business districts and to inspect the wiring at large institutions, such as hospitals, colleges and schools.

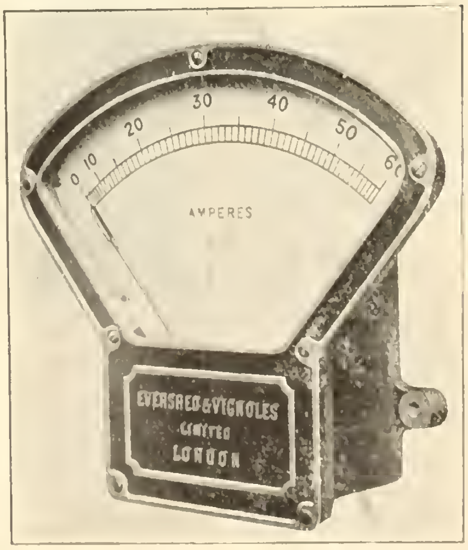
The Ogilvie Flour Mills at Winnipeg have discarded their steam engine, and are now using electricity as the motive power. For this purpose the Canadian General Electric Company furnished a 1,200 horse-power motor directly connected to the shaft in the main mill, and several smaller motors of 150 horse-power in the adjoining premises. This direct motor connection does away with the belted or rope drive, and supersedes mechanical clutches for connecting the revolving shaft with the motors.

MUNICIPAL OWNERSHIP.

Recent failures in municipal ownership in England include an important case in Bath. The city authorities there voted by 42 to 2 to sell the municipal electric plant, which has been a failure, to a private syndicate. The transaction means the immediate reduction of the local rate of taxation. Lord Avebury issued another brochure on municipal ownership, in which he again condemns the whole principle as false democracy and bad policy. His conclusions are:— "Monopolies are bad, but especially municipal monopolies, because they are the most difficult either to regulate, control or abolish. I doubt whether the paper profit which municipalities claim to have made is any real existence. Municipal trading must increase our rates more and more, while at the same time it raises the prices of necessaries, so that it cuts down incomes with one hand and with the other makes life more expensive."

The city of New York now owes its contractors for electric lighting something over $10,000,000. The delay in payment is due to a dispute as to the price, and the matter is still in the courts. Some time ago the civic authorities reached an agreement, but W. R. Hearst got out an injunction and prevented the settlement being put into effect. It is calculated that Mr. Heart's injunction has already cost the city $700,000, and is adding $600,000 a year to the bill, interest being charged at 6 per cent. on the unpaid account. It is doubtful if even Mr. Hearst got that much worth of advertising out of his injunction.





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PUBLICATIONS.

The Canadian General Electric Company are distributing a booklet entitled "Ironing by Electricity."

Literature has recently come to hand from the Concordia Electric Wire Company 34 Queen street, London, England. This company are manufacturers of insulated wires and cables, fuses, etc., and make a specialty of silver covered copper and high resistance wire.

The Norman W. Henley Publishing Company, 132 Nassau street, New York, have just published a very complete work entitled "Modern Steam Engineering in Theory and Practise," the author being Gardner D. Hiscox, M.E. The book contains 487 pages and is illustrated by 405 specially made engravings and diagrams. Among the many valuable features are 42 tables of the properties and application of steam in its various uses, and answers to nearly 200 questions on steam and electrical engineering. There is also an electrical section by Newton Harrison, E.E. The price of the book is $3.00.

The Manhattan Electrical Supply Company, New York, have just issued a condensed catalogue, No. 22, covering "Something Electrical for Everybody." It contains 144 pages and over 750 illustrations of goods manufactured and handled by them, and is one of the most comprehensive catalogues for its size ever published, including as it does electrician's supplies, telegraph instruments and supplies, automobile and motor boat sundries, telephones and telephone supplies, electrical novelties, burglar and fire alarms, automatic gas lighting specialties, linemen's equipment, medical apparatus and laboratory supplies—in fact anything and everything pertaining to electricity. The company will be pleased to send a copy of the catalogue to anyone interested.

The new catalogue, G4, of the Gilson Manufacturing Company, of Port Washington, Wis., illustrating and describing their full line of widely known Gilson engines—gasoline, gas, alcohol—is now ready for distribution. This catalogue gives a complete description, with many fine illustrations, of the famous Goes-Like-Sixty line of Gilson engines, air, water and oil cooled. It also describes their latest and greatest production, the $5\frac{1}{2}$ horse-power double opposed, air cooled engine. The Canadian factory of the Gilson Manufacturing Company is now being built at Guelph, Ontario. Here within a few weeks will be built the complete line of engines produced by this progressive and up-to-date concern. The new catalogue will be sent postpaid anywhere on request.

PERSONAL.

Mr. W. H. Green, manager of the municipal electric light plant at Wingham, Ont., has resigned, and has been succeeded by Mr. W. J. Wyle.

Mr. C. M. Wilson, traffic manager of the York Radial Railway, Toronto, has been promoted to the position of assistant general manager, and will be succeeded as traffic manager by Mr. Fred Livingston.

Mr. J. A. Killingsworth has been appointed manager of the street railway system at St. Thomas, Ont., which is operaated under municipal ownership. Mr. A. S. Balsden has been appointed electrician, and will have charge of the equipment and car barns.

Mr. W. G. Slack, chief accountant of the Bell Telephone Company, has been appointed acting secretary-treasurer of the company, pro tem, to succeed the late Mr. C. P. Sclater. Mr. Slack has been associated with the Bell Company since its organization in 1880.

Mr. H. F. Schaedel, who has been manager of the Sunbeam Incandescent Lamp Company's factory at St. Catharines, Ont., has been appointed to a more lucrative position in the company's works at Conneaut, Ohio. His departure from St. Catharines is much regretted, and the employees of the factory presented him with a gold mounted umbrella, accompanied by an address.

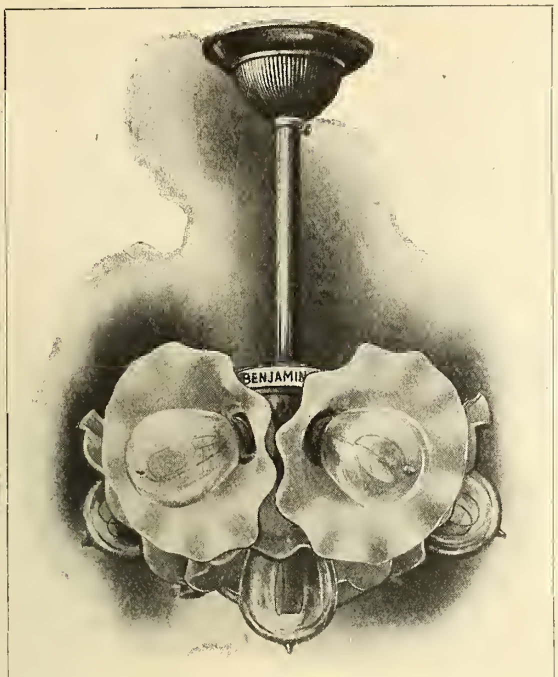
Mr. J. McMillan, assistant superintendent of C. P. R. telegraphs at Winnipeg, has been appointed to the position of superintendent of telegraphs of the western division, with headquarters at Calgary. Before his departure Mr. McMillan was banqueted by the employees of the C. P. R. telegraph and maintenance department, on which occasion he was presented with a gold watch, suitably engraved.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

SEVENTEENTH YEAR. No. 4. | TORONTO, MONTREAL — MAY, 1907 — WINNIPEG, VANCOUVER | PRICE 10 CENTS $1.00 PER YEAR.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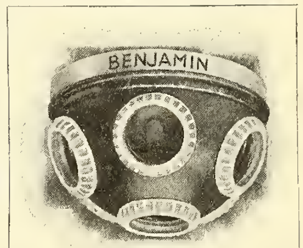
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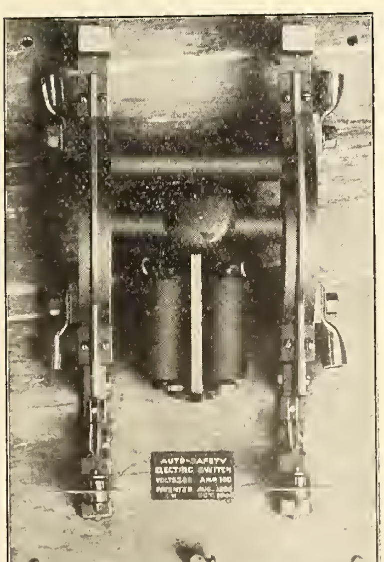
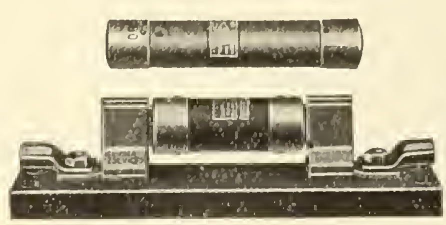
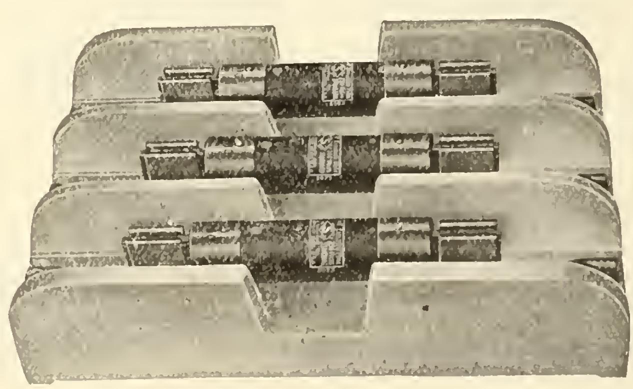


Fuses



Bases



MOONLIGHT SCHEDULE FOR JUNE

Date.	Light.	Date.	Extinguish.	No. of Hours.
June 1	8 00	June 2	1 45	5 45
2	8 00	3	2 20	6 20
3	8 00	4	3 00	7 00
4	8 00	5	3 30	7 30
5	8 00	6	3 30	7 30
6	8 00	7	3 30	7 30
7	8 00	8	3 30	7 30
8	8 00	9	3 30	7 30
9	8 00	10	3 30	7 30
10	8 00	11	3 30	7 30
11	8 00	12	3 30	7 30
12	8 00	13	3 30	7 30
13	8 00	14	3 30	7 30
14	8 00	15	3 30	7 30
15	8 00	16	3 30	7 30
16	10 00	17	3 30	5 30
17	10 30	18	3 30	5 00
18	11 00	19	3 30	4 30
19	11 30	20	3 30	4 00
21	0 00	21	3 30	3 30
22	0 30	22	3 30	3 00
23	1 10	23	3 30	2 20
24	No Light	24	No Light	
25	No Light	25	No Light	
26	8 10	26	10 10	2 00
27	8 10	27	11 00	2 50
28	8 10	28	11 45	3 35
29	8 10	30	0 30	4 20
30	8 10	July 1	1 00	4 50
			Total	154 30

The Stark Telephone, Light & Power System, Limited, of Toronto, have given the St. Catharines City Council a cheque for $1,350 to cover the loss to the city by default of the company to begin city lighting on May 1st. The city was satisfied, and will execute a new by-law to re-arrange the matter of lighting by granting the company six months' extension.

SPARKS.

The Town Council of Owen Sound, Ont., have accepted the tender of the Canadian General Electric Company for three 50 kw. transformers, and that of C. W. Bongard, Toronto, for copper wire and glass insulators.

The contract for street lighting in the city of Quebec for five years has been awarded to the Quebec & Jacques Cartier Power Company, at $62.10 for arc lights and $24 for 65 c.p. lamps. The Quebec Railway, Light & Power Company will supply the park lighting at $40 for arc lights and $10 for 65 c.p. lamps.

The Manitoba Radial Railway Company was recently incorporated by the Dominion Government, the incorporators being Messrs. Charles Hoffman, Arthur Wagner, R. D. Fletcher, John A. Munro and W. J. Donovan. The capital of the new company is fixed at $500,000, and it is proposed to construct a railway from Winnipeg to Lake Manitoba, Sundar, Stonewall, and other points. Water powers will probably be developed.

SPARKS.

Souris, Man., may develop a water power on the Souris river, where a 21 foot head will give from 600 to 800 h.p.

The city of Prince Albert, Sask., is about to erect a brick and stone power house, for which the contract will be awarded this month.

The Board of Control of the City of Winnipeg have just taken tenders for the supply of switchboards, regulators, etc., for the new sub-station on May street.

The announcement was recently made that the Oji Paper Company, of Tokio, Japan, had placed a $1,000,000 order for electrical equipment with the General Electric Company, of Schenectady, N.Y.

The British Columbia Electric Railway Company are planning for extensive additions to their property in New Westminster, and it is said will spend $100,000 on new buildings, including distributing stations, freight sheds, etc.

Mr. K. L. Aitken, consulting engineer, of Toronto, presented for discussion a paper entitled "Synchronous Converters vs. Motor Generator Sets," by Mr. Paul M. Lincoln, at the April meeting of the Toronto branch of the American Institute of Electrical Engineers.

CLASSIFIED INDEX OF ADVERTISERS.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XVII. MAY, 1907 No. 5

The Huronian Company's Power Development*

By Robert A. Ross and Henry Holgate, Consulting Engineers.

The Canadian Copper Company operates numerous nickel and copper mines in what is known as the Sudbury District, the principal mines being at Copper Cliff, Creighton, and Crean Hill. The smelter at which these ores are treated is located at Copper Cliff. To develop and transmit power for their requirements and for other purposes the Huronian Company was incorporated.

Huronian Company's Power Development—General Site, High Falls.

The cost of coal for operating the smelting plant and machinery at the mines induced the Huronian Company to acquire the property known as High Falls, on the Spanish River, in the Township of Hyman, and in the spring of 1904 work was begun upon the development of this water power.

High Falls lies about four miles north of the "Soo Branch" of the Canadian Pacific Railway, at a point about 28 1-3 miles west of Sudbury. A line of railway was built from the C. P. R. to the site of the works, and all necessary buildings were erected for housing the workmen and storing material This preliminary work was ready about September 1st, when work on the actual development was commenced.

The Spanish River, when it reaches High Falls, drains an area of 2,150 square miles. The average rainfall of this area is not in excess of 30 inches, and during one season, when the rainfall did not exceed 24 inches, the minimum discharge of the river was 1,600 cubic feet per second. The best description of the character of this watershed is found in Dr. Robert Bell's report in the Geological Survey of Canada for 1888-1890. It is owing to the nature of the covering of this watershed and to the numerous lakes in the upper reaches that the minimum flow is high, being .71 cubic foot per second per square mile. The minimum flow of the stream was reached in September, 1904, and also in February, 1905.

Above High Falls, for a distance of six miles, the river is a succession of rapids, and it was considered necessary that these should be drowned so as to prevent the formation of frazil, and to form as much of a reservoir as possible. For these reasons the river level above the falls was raised 18 feet, drowning all troublesome rapids, providing a storage basin about six miles long, and increasing the head from 67 to 85 feet.

Huronian Company's Power Development—Power Station, High Falls.

The river above the falls flows between rocks and hills. Immediately at the head of the falls are rocky

*Paper read at a joint meeting of the Mechanical and Electrical Sections of the Canadian Society of Civil Engineers, Montreal, April 25, 1907. Some of the illustrations accompanying the original paper are not here reproduced.

islands, which break the stream into several channels, finally dividing the river into the east and west channels, the two branches uniting a short distance below and thus forming High Falls Island.

The system of dams necessary to control the water was somewhat complicated, and work on concrete dams 1, 2 and 4 was begun first and carried on continuously to completion, notwithstanding the severe winter of 1904-5. At the same time the concrete foundations of the power house were built to above high water, so as to avoid any delay in the following spring. A log slide and two temporary openings were

HURONIAN COMPANY'S POWER DEVELOPMENT—DAM AND FOREBAY.

left in dams 1 and 2, so as to pass water when it became necessary to stop the water on the east side of the river. The channel on the east side was then closed up by a crib cofferdam against a head of 32 feet of water. This cofferdam was built in the form of the letter "V" in plan, each leg abutting on the rock projecting outwards and up stream at an angle and finished square, leaving a key-shape space between the two legs. Accurate measurements were made of this space, and a crib of these dimensions was built up stream a short distance, loaded, and then lowered with heavy tackle to within a short distance of its proposed location, and was then built up and loaded until it was within a few inches of the bottom. When this was completed the position of the key crib was adjusted; then it was lowered as far as possible under control of the ropes, and when the proper direction of its course was assured, the tackle was quickly slacked and the crib under the action of the current went into its position. The face of the cofferdam was then double sheeted and made as tight as the bottom formation would allow, so that the water was thus diverted to the openings in dams 1 and 2.

As will be seen on plan No. 2, the water for the power plant was taken across the Island, and to do this it was necessary to construct series of dams, 5, 6 and 7, connecting with the bulkhead, and to close the west channel by dam 3, after which the openings in dams 1 and 2 were closed and the forebay allowed to fill. All of the structures, including the power house, are built on rock, and the forebay to elevation 170 is cut through rock. In dams No. 3 and No. 5 are sluices at level 159, which, with the aid of the logslide and penstock, allow (if ever it should be necessary), the water to be lowered to below 170 and render the racks and bulkhead accessible for repairs. These sluices are also intended to be used to relieve the overflow at high water, and are accessible by bridges from the shore ends of the dam.

As the river is used for lumbering purposes, and as large numbers of logs come down every year, the provision for their passage was made in No. 2 dam, a system of booms being anchored above to guide the logs to the slide, which carries them to the west channel. In order to ensure water in the west channel, the crest of dam No. 3 was made 18 inches higher than dam No. 5, so that a continual flow is assured in the west channel for logging purposes.

From the photographs and general plan will be plainly seen the whole scheme of dams and works, which is of somewhat unusual design, but which was considered the best possible arrangement to secure the full flow of the river, to meet the lumbermen's demand, and also to make advantageous use of the physical peculiarities of the site.

DAMS.—All of the dams are founded on solid rock, ample key trenches being cut in the rock for anchorages, both in the foundation and end walls. The foundation rock was made absolutely clean, not a particle of dust or dirt was allowed to remain, the bottom was then dusted over with neat cement, and over this a layer of mortar 1 to 3 was laid to a minimum depth of 4 inches, when regular concreting was begun. The concrete mixture was all 1 cement, 3 sand, and 5 of broken stone, well mixed, and deposited in a very wet mixture. Larger stones were freely used, some

HURONIAN COMPANY'S POWER DEVELOPMENT—DAM ON WEST SIDE OF RIVER.

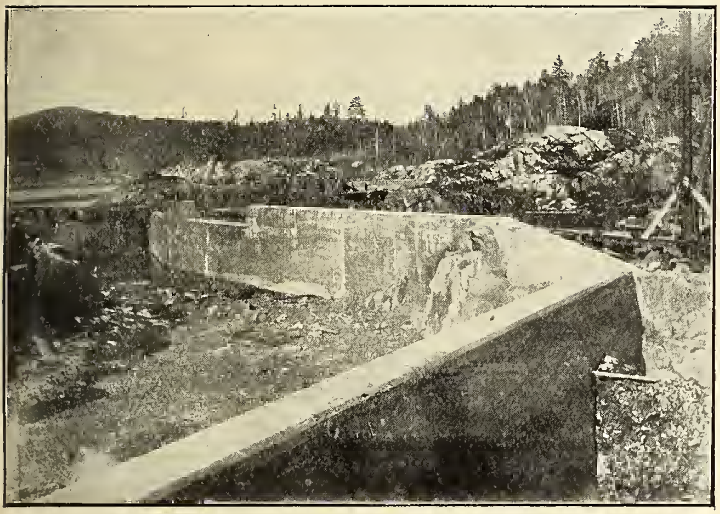
measuring over two cubic yards, none being allowed nearer the face of the work than 9 inches, nor nearer each other than 12 inches. All being carefully washed and scrubbed before placing, carefully bedded, and so disposed as to form as effective a bond in the work as possible, the wet condition of the concrete mass facilitating this bedding.

Though a large part of the concrete work in dams, and also in power house foundations was done in winter, with the temperature varying from a few degrees of frost to 15 degrees below zero (and on several occasions much lower), no difficulty was found in securing

good concrete work, the only precautions taken being to heat the mixing water by turning a three-quarter inch steam pipe into the water barrel supplying the mixer, and, during the process of mixing, to use a jet of live steam in the mixer, keeping the cylinder closed by wooden coverings during the process of mixing. No attempt was made to head sand or stone, nor was such at all necessary.

In all the winter work care was taken to use only cement which would attain its initial set in not more than 65 minutes, and the results obtained have been absolutely satisfactory.

Except in very thin walls there need be no hesita-



Huronian Company's Power Development—No. 3 Dam and Forebay.

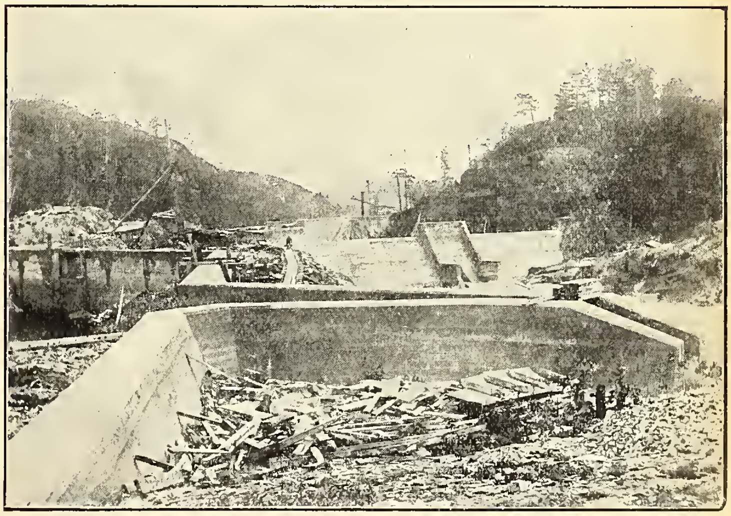
tion in placing concrete in low temperature if the above precautions are taken. Even in thin walls (10 inches or over), it can be safely done, as was done in the case of the sub-station and blowing engine house constructed in connection with this plant at Copper Cliff, which was built during the winter of 1905-6, and which, except for the additional cost, does not differ from work done above the freezing point.

Bulkhead Wall.—This was constructed generally in the same manner as the other dams, the steel structure for racks and the cones for penstocks being built in the work, all steel work being carefully bedded in and covered with wet mortar. The general arrangement of the bulkhead and penstock inlets are shown on the diagram. The gates are of steel of split pattern, and are operated by a direct current motor driven from the exciters, or by hand, as required. The exciter inlet is separate from the power wheel inlets, so as to permit of a smaller screen spacing being used in the racks. This necessity at the inlet, and the advisability of having the exciters placed in the middle of the power house floor, required the bending of the exciter penstock from the end of the bulkhead wall to a position in the centre of the power house, as the drawings indicate. The bulkhead was housed, so as to protect the operators in severe winter weather.

Penstocks.—The entrance cones, built in the concrete wall, are 10 feet in diameter at the upper end, and 9 feet in diameter at the outside of the wall; the penstocks are 9 feet in diameter from this point to the wheel cases, and are of steel plate, resting on concrete saddles, spaced at two diameters of the penstock centre. The penstocks are four in number and are anchored in the centre of their length, an expansion joint being provided near the bulkhead wall, and also one near the power house in each. To prevent the formation of ice in the penstocks, they are covered with a wooden structure, made as nearly air tight as possible, and this arrangement is quite effective and necessary in a plant operating in this locality, where the temperature sometimes reaches 45 degrees below zero. The maximum speed of water in the penstocks is at full overload 7.2 feet per second. Air pipes of ample capacity, protected from freezing, are provided at the upper end of the penstocks.

Power House.—The foundations of the building are carried down to rock, which dipped to the north and east at a depth of about 30 feet below the floor level. The overlying material was soft blue clay and quicksand, which gave a good deal of trouble in excavating, though the low temperature at which most of the work was done tended to facilitate rather than retard progress, as every opportunity was given the frost to penetrate the earth beyond the limits of the excavation, rendering the standing walls secure and enabling the excavation to be carried down on about plumb. The sub-floor work consisted of concrete walls, piers, and arches, as shown.

The floor arrangement of the power house provides for two exciters in the middle of the room, each capable of serving four generators, both being furnished with water from one penstock, and each provided with an hydraulically operated gate valve. The power units are arranged with two on each side of the exciters. In the centre of the building is the switch tower, and on each side of it are the transformer compartments, separated from the main room by steel doors. A railway track leads into the power house, and an overhead crane commands all the machinery, the transformers being all mounted on trucks, which can be



Huronian Company's Power Development—Log Chute in Foreground

pushed forward so as to bring them under the crane.

The base of the operating platform is faced with enamelled brick, the platform itself being reached by a removable iron stairway at each side.

The roof of the transformer rooms and of the switch tower is of concrete, and the roof of the main building is of pine, 2 inches x 4 inches, laid on edge on steel trusses, and covered with 26 gauge galvanized iron. The building is heated from a boiler placed in a room on the east end of the building, the Sturtevant system of warm air being used. A room is also

provided for stores and small repair work furnished with a complete lavatory. The tail race was excavated to ample size, and some necessary retaining walls and cribs were built for its protection.

The walls of the power house were built of red brick, laid in a mortar consisting of Portland cement and lime; the inside well finished and the walls painted for six feet above the floor, while the remainder of the walls were tinted a buff color.

Turbines, Etc.—The main turbine wheels were designed for a maximum of 3,550 h.p. each. Each turbine operated a 2,000 kw. generator, so that the wheels have a capacity sufficient for operating the generators at 33 per cent. overload. The effective head is 85 feet, and the speed is 375 r.p.m. The wheels are enclosed in steel cases, with case and head split horizontally, so as to give quick access to the moving parts in case of repairs being necessary. One pair of wheels is used in each unit, the diameter being 34 inches, the runner being of bronze. The thrust bearing is of the marine type, located between the wheel case and the generator. The case head bearing is in effect merely a stuffing box and really takes no weight. The gates are of bronze of wicket design, being as nearly as possible balanced, and are operated by a governor of the Sturgess type. The exciter turbines are similar in design, and are also controlled by Sturgess governors; all governors are electrically controlled, being handled from the controlling desk by the operator on duty, who can start up any or all machines from this point. The total full load capacity of the station is 8,000 kw.

Tachometers are attached to each main unit.

Generators.—The electrical plant was designed for the eventual installation of four generators, two of which are at present operating, and a third has been contracted for. These generators are each of 2,000 kw. capacity at 80 per cent. power factor, 3 phase, 25 cycles, operating at 2,400 volts. The revolving field is mounted on a steel shaft with the coupling forged out of the solid and directly connected to the water wheels.

Exciters.—The exciters, two in number, are of 200 kw. capacity each, operated at 550 r.p.m., each being of a capacity sufficient to furnish excitation for the four generators. These exciters are also directly connected to their own wheels.

In connection with the testing of the generators, it may be interesting to note that loads were obtained by connecting one generator up as a motor reversed in direction of rotation and operating it from the other machine running as a generator. Both machines, for the purpose of the tests, were brought up to full excitation and switched together before being started up. The gates on the generator wheel being opened up gradually, both machines came up to speed, the motor, of course, driving its wheel in the opposite direction to normal rotation. When both machines were at speed, the gates on the wheel connected to the motor were gradually opened, thus obtaining practically a water brake load. It was possible by this means to get any load required, and also to reach any power factor by over or under exciting the synchronous motor, thus determining the regulation of the generator at any power factor. This scheme is decidedly superior to a water rheostat load, which, in addition to troubles of its own, gives only a fixed power factor.

Switchboard.—The switchboard arrangement was laid out so that any generator, set of transformers, or line might be operated together or operated singly in any combination.

The marble benchboard from which the operation of the station is controlled in every particular, including the speeding of the water wheels, was placed on a gallery to give the operator a clear view of the power station and the switching apparatus in the tower. The switches, being distantly controlled, are placed on two floors of the switching and line tower, the 35,000 volt out-going line switches, together with the lightning arresters, being placed at the top of the tower, and the 2,200 volt apparatus in the base, so that on the benchboard the only voltages are those from the exciter and the operating voltages from the switch controls. In other words, nothing higher than 125 volts is admitted to the main power station, except within the generators themselves, which have no exposed parts, and the current from which is carried by cables in ducts to the low voltage chamber in the switch tower.

All of the bus bars, switches, etc., in the tower, are properly barriered by concrete slab construction.

The benchboard is low, and instead of using marble panels for the instruments, which would have obstructed the view of the station, ornamental pillars, carrying all instruments, were installed along the face of the controlling platform.

All switching and other operations are governed by small control switches, with indicating lamps on the board; and on the wall, opposite the benchboard, is set a large synchroscope and the visual bell signal system for each power unit. A synchronizer is also located on one of the instrument pillars.

In the compartment below the benchboard platform is located the motor-driven air compressor, used to supply air for cleaning purposes. This air is piped to a number of accessible places throughout the main floor, transformer rooms, and also to the tower for cleaning lightning arresters, etc.

The exciter and generator field rheostats are also located in this compartment.

Transformers.—Two groups of three transformers each were installed with the first equipment, and the third set has been contracted for. These are placed in a transformer room extending along the entire length of the power house and sub-divided into four compartments, thus isolating each group of three transformers from the rest.

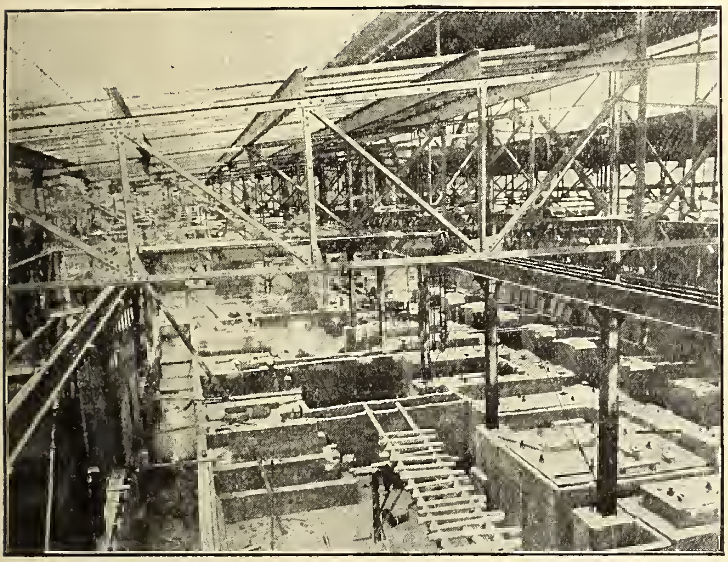
The specifications for these transformers required that the cases were to be constructed entirely of boiler iron, designed to withstand an explosive pressure of 150 lbs. per square inch, and so arranged as to be full of oil at all times, being kept in this condition by means of a system of piping extending to an expansion tank on the wall, which was carefully covered. With the precautions taken, no space in the cases is allowed for gas to accumulate, and, therefore, no explosions will be possible under proper supervision. If, however, through carelessness, the oil were to be allowed to sink below the level of the tops of the transformers and an explosion should take place, no harm would be done outside the case, as the pressure

generated by an oil gas explosion is never over 100 pounds per square inch.

In case of a short circuit in the coils, the heat generated expands the coil and throws it into the tank, which also provides for the inevitable expansion and contraction of the oil in the transformer case as the apparatus heats up or cools off.

This is the first time the engineers have used this scheme in their practice, and owing to its success in this plant will continue to use it for all future work.

For handling the oil, a piping system is provided, with an underground tank at one end of the building,



Huronian Company's Power Development—Main Sub-Station, Copper Cliff.

divided into two parts; one for spare clean oil, and the other for dirty oil, the latter running from the transformer to the tank by gravity, while the clean oil is forced into the cases as required, by compressed air, which is obtained from the air tank and compressor used for blowing dust out of the generators and switches.

Some strenuous criticisms were offered to this method by the transformer builders, who took the ground that moisture from the air, under compression, would be sure to be forced into the oil, thus rendering it unfit for use. To demonstrate the fallacy of this, a quantity of oil was forced by air backwards and forwards a number of times into and out of two interconnected vessels, and after this test absolutely no moisture could be detected. It may be stated, however, that no air is taken directly from the air pump, but from the air pump tank, in which all the moisture due to compression is deposited. As the air compressor for blowing out purposes is essential in any modern plant, this scheme affords a means of handling the oil safely and economically.

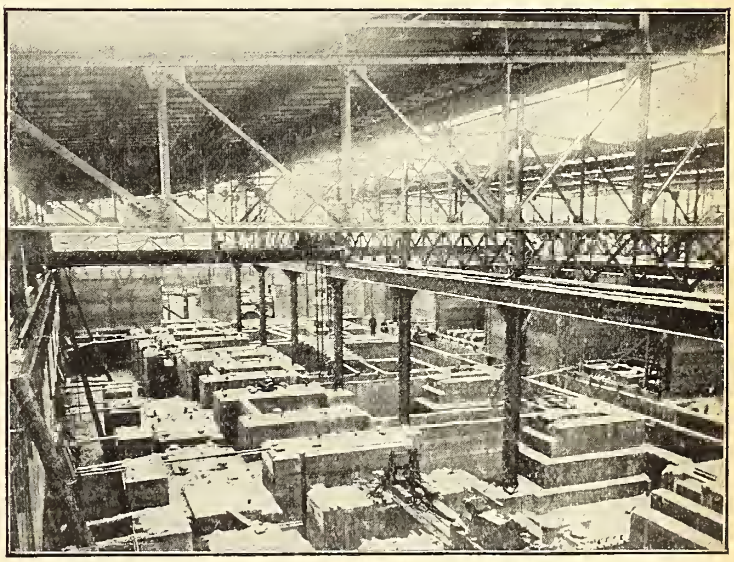
Fire Protection.—For fire protection of the wooden penstock covering, bulkhead structure, and other buildings, a 500 gallon, 2-stage turbine pump, directly connected to a 50 h.p. direct current motor and supplied with current from the excited circuit, has been located between units Nos. 1 and 2, with water connection to both penstocks, so as to ensure at all times a supply of water to the pump. From the pump a dry pipe line has been run with outlets at various points along the penstock, and a line has also been carried over to protect the houses of the employees.

Transmission Line.—The transmission line from High Falls to Copper Cliff, operating at 35,000 volts, is about 29 miles long, and runs for the most part upon a right of way acquired immediately outside that of the Soo Branch of the Canadian Pacific Railway, thus affording ready access from the railway at all points. The line consists of two 3-phase circuits of No. 1 wire, one line being transposed three times, and the other running straight through.

The telephone line was placed on the Canadian Pacific Railway Company's telegraph poles on the opposite side of the track, at a distance of about 80 feet, to avoid the possibility of induction.

The pole line construction is shown in Figure No. 7, and it will be noted that specially designed malleable iron pins are used, with a double pole construction throughout. Owing to the wide spacing of wires, it would be impossible to carry the two circuits on one pole, so that in the interest of structural stability it was advisable, instead of installing a second pole line, to combine the two with a common cross arm; these cross arms being made of long leaf Southern pine. This gives a very solid structure, and eliminates a lot of guying and strutting, which is always objectionable.

The insulators were tested at the works of the makers by a representative of the engineers for a period of 15 minutes at a voltage of 70,000, and the result of this very rigid test, especially as regards time, was that the lines were energized without a single breakdown. Since that time they have given absolutely no

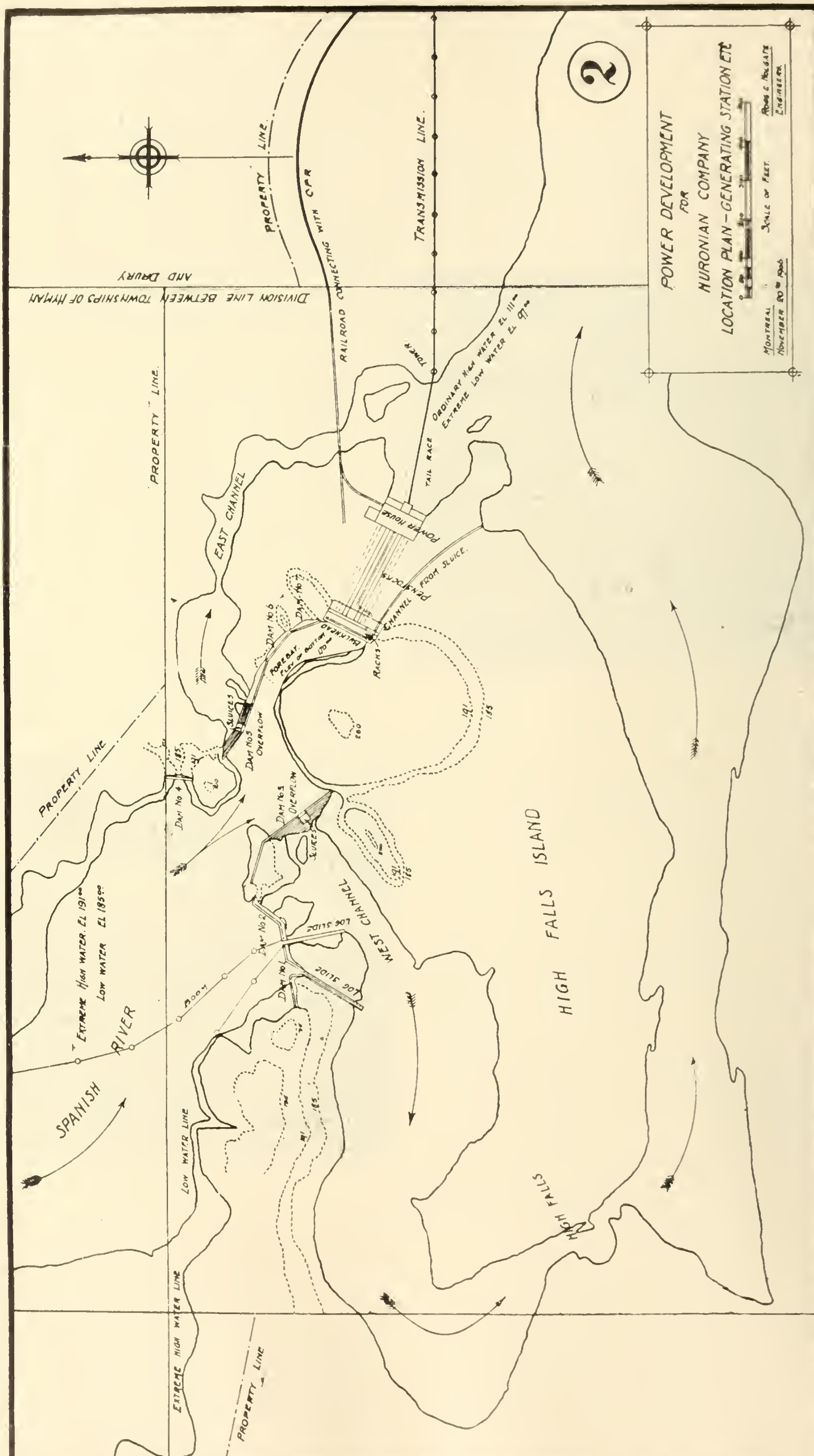


Huronian Company's Power Development—Main Sub-Station, Copper Cliff.

trouble, except where insulators have been shattered by bullets or other missiles.

The high tension exits of the lines from the power station and entrances to the sub-stations have been made through 18 inch tiles with plate glass screens, and have given no trouble, except at the sub-station at Copper Cliff, where sulphur fumes and metallic dust from the smelter have deposited from time to time, forming a scum, over which leakage has taken place. This has been remedied.

Aerial switches for isolating the branches to Crean Hill and Creighton Mines, as shown on photographs,


2
POWER DEVELOPMENT
FOR
HURONIAN COMPANY
LOCATION PLAN—GENERATING STATION ETC
SCALE OF FEET
ROSS & HOLGATE
ENGINEERS
MONTREAL
TRANSMISSION LINE
PROPERTY LINE
RAILROAD CONNECTING WITH CPR
DIVISION LINE BETWEEN TOWNSHIPS OF HYMAN AND DRURY
TOWER
ORDINARY HIGH WATER EL 111.00
EXTREME LOW WATER EL 97.00
TAIL RACE
POWER HOUSE
PENSTOCKS
CHANNEL FROM SLUICE
EAST CHANNEL
BULKHEAD
RACKS
FOREBAY
DAM No 6
DAM No 7
SLUICES
DAM No 5
OVERFLOW
DAM No 4
DAM No 3
OVERFLOW
SLUICES
DAM No 2
DAM No 1
LOG SLIDE
LOG SLIDE
WEST CHANNEL
HIGH FALLS ISLAND
HIGH FALLS
EXTREME HIGH WATER EL 191.00
LOW WATER EL 185.00
BOOM
SPANISH RIVER
LOW WATER LINE
EXTREME HIGH WATER LINE
PROPERTY LINE

have been located at Victoria Mine and the Quartz Quarry. These switches were not designed to open the circuit with any load on at the sub-stations, but simply to open the branch lines in case any repairs were necessary while the main line was alive. These aerial switches are both connected to the same line, the other main line running straight through to Copper Cliff sub-station.

SUB-STATION, COPPER CLIFF.—The main sub-station is at Copper Cliff, and contains, in addition to electrical apparatus, some very interesting machinery for the operation of the smelter, etc., as follows:

EQUIPMENT.

6 667 kw. transformers, 35,000 to 2,400 volts.

3 175 kw. transformers, 2,400 to 575 volts.

1 40 kw. motor generator set, 575 A.C. to 250 D.C., for operating furnace charging locomotives.

1 75 kw. frequency changer set, 25 to 60 cycles, for operating the A.C. series arc circuits used for lighting the streets.

13 feeder and control panels for transformers, motors, lighting, etc.

1 Storage battery for operating distant control switches.

75 light capacity in constant current A.C. arc regulators.

3 600 h.p. induction motors, each connected to a blowing engine having a capacity of 35,000 cubic feet of air at 40 oz. pressure. These blowing engines are driven by the motor with 18 1-2 inch Manilla ropes on the English system.
The motors are fitted with a special speed-changing controller, arranged for controlling speed by changing the number of poles in stator, with electric locking device to prevent the operation of controller when motor is in operation.
These motors are mounted on base rails, and are fitted with the regular starting compensators and circuit breakers.

1 300 h.p induction motor directly connected to a compound air compressor operating at 100 lbs. pressure and 120 revolutions per minute. The speed of this motor is constant, the compressor being fitted with an unloading device. which is automatically brought into use when the pressure rises or falls below 100 lbs. This motor is fitted with starting compensator and circuit breaker.

1 500 h.p. induction motor, constant speed, operating at 375 r.p.m., connected to a blow engine having a capacity of 10,400 cubic feet of air at 12 lbs. pressure, and driven by 16 1 1-2 inch Manilla ropes on the English system.
This motor is mounted on sliding base rails, and is equipped with the regular starting compensator and circuit breakers.
Space is provided for a second blowing engine of the same capacity as above engine.

1 4-stage 6-inch turbine pump directly connected to a 225 h.p induction motor; this outfit being used for fire protection, is connected to a dry fire line, which is piped around yards and buildings. The supply of water to this pump is taken from a 16 inch water main under 20 lbs. pressure, being obtained from a series of small lakes by gravity.

1 2 inch vertical pump and direct connected motor, with automatic starting switch, operated by a float, is used to pump the water from the sump, which is located in the basement. The transformer cooling water drains into this sump, as well as any seapage.

2 8 inch single-stage turbine pumps, directly connected to 80 h.p. induction motors, housed in a separate pump house, which are used to circulate the water supply to the furnace jackets.

1 5 inch 2-stage turbine pump, directly connected to a 50 h.p. induction motor, is located near the smelter furnace gallery, which pump is held in reserve in case of the molten metal burning its way through between the furnace jackets. This pump is used to supply water to chill same and stop the flow of metal.

1 10 h.p. induction motor belted to a Sturtevant blower and located in sub-station, is used in connection with the hot blast heating system of the substation.

It will be noted that the motors here installed are very large, and, being connected to air compressors of great size, take a very large amount of current on starting up. Owing to these conditions, the lighting is by no means as perfect as if the motor units were smaller, but no serious trouble has been encountered from this cause.

This sub-station is constructed entirely of concrete, with a steel frame and book tile roof, and covers approximately one-half acre of ground.

The apparatus contained in this station, including two 10-ton cranes, together with all the air piping to the smelter, was contracted for and installed by the engineers of the Huronian Company's plant, the whole forming a rather interesting application of electricity for mining and smelter purposes.

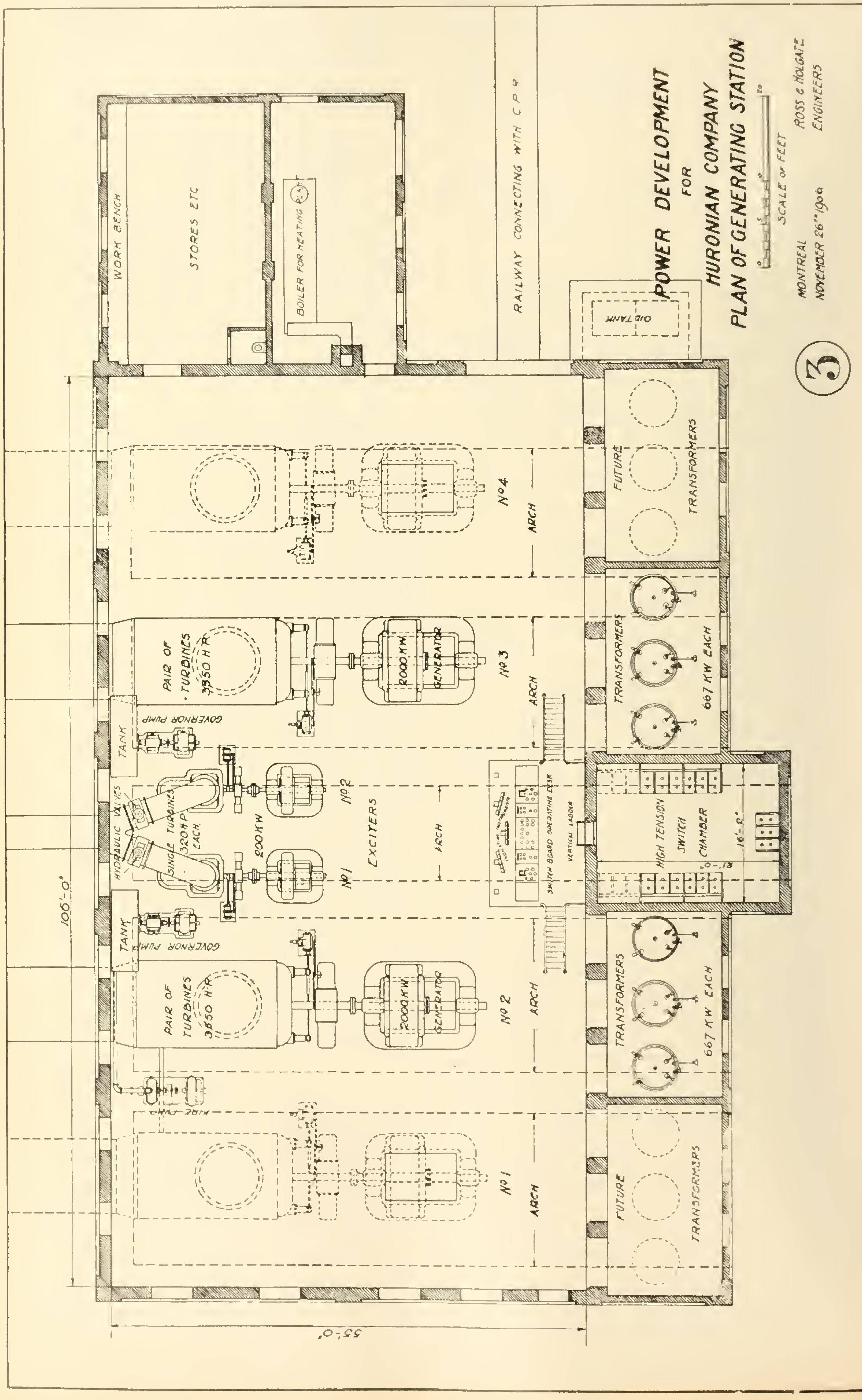
CRANES.—In addition, two 40-ton alternating current cranes, with five motors each, have been installed in the smelter for the handling of ladles carrying melted matte, and in spite of predictions to the contrary, these handle perfectly, pouring the metal into the converters as readily as by a hand ladle. These alternating current motors operate under the most adverse conditions, in an atmosphere of tremendous heat and covered with sulphur fumes and metallic dust from the furnaces and converters.

The converters also are tipped by alternating current motors from a controlling stand some distance away.

CREAN HILL SUB-STATION.—This sub-station is connected to the first branch taken off one of the two main transmission lines, which is approximately 3 1-2 miles long and of single pole construction, with special aerial switches located at point of departure from the main line. The sub-station building is constructed of concrete and brick and provided with a 10-ton hand power travelling crane.

For the housing of lightning arresters, high tension line switch, choke coils, disconnecting switches, etc., a tower has been provided in one corner of the building.

For the reception of the 3 175 kw. 35,000 to 550 volt, oil-filled, water-cooled transformers, a special


POWER DEVELOPMENT
FOR
HURONIAN COMPANY
PLAN OF GENERATING STATION
SCALE OF FEET
ROSS & HOLGATE
ENGINEERS
MONTREAL
NOVEMBER 26th 1906
3
WORK BENCH
STORES ETC
BOILER FOR HEATING PLANT
RAILWAY CONNECTING WITH C P R
OIL TANK
FUTURE
TRANSFORMERS
TRANSFORMERS
667 KW EACH
HIGH TENSION
SWITCH
CHAMBER
16'-8"
SWITCH BOARD OPERATING DESK
VERTICAL LADDER
No 4
ARCH
No 3
PAIR OF
TURBINES
3350 H.P.
2000 KW
GENERATOR
GOVERNOR PUMP
TANK
HYDRAULIC VALVES
SINGLE TURBINES
320 H.P.
EACH
200 KW
EXCITERS
No 1
No 2
No 2
FIRE PUMP
No 1
106'-0"
55'-0"

fireproof compartment has been provided with iron doors, so as to completely isolate the transformers from the main building, this being practically the same scheme as followed at the main power house at High Falls.

For the control and distribution of power to the various receivers throughout the mines, the necessary totalling and feeder panels have been provided, the cables to and from same being run in fibre conduit and laid in the concrete floor.

Air Supply.—For supply of air to the mines, a compound, direct driven air compressor has been supplied, operating at 120 r.p.m. and supplying 1,635 cubic feet of free air per minute, with an intercooler of extra large capacity. As the speed is constant, regulation is obtained by automatic Corliss valve step regulation.

For driving the compressor, a 2,300 h.p. 3-phase 550 volt induction motor has been installed, with the motor mounted on the main shaft of the compressor, operating at 120 r.p.m. and provided with all the necessary starting compensator, circuit breakers, and panel.

Mine Hoist.—In connection with the operation of the mine skips, a special three-drum mine hoist has been installed, the drums of which are arranged for the operation of two drums in counterbalance, also independently, or all three together if necessary. The rope speed is 500 feet per minute, and the capacity of each skip 6,000 lbs.

For the operation of this hoist, a 150 h.p 3-phase variable speed induction motor has been provided, complete with reversing controller, resistances, circuit breaker, panel, etc.

Fire Protection.—For the protection of the buildings and plant, a 1,000 gallon 6 inch 4-stage fire pump directly connected to a 150 h.p 3-phase 550 volt induction motor has been installed; also a dry fire line has been piped to various points throughout the plant.

Cooling Water for Compressor and Transformers.—The water for cooling the compressor and transformers is kept in circulation by the aid of a 250 gallon 3 inch single-stage centrifugal pump, directly connected to a 5 h.p. 3-phase 550 volt induction motor, operating at 1,500 r.p.m.

Water Supply.—For storage of water for the fire pump supply, a steel tank holding 60,000 gallons has been erected close to the sub-station, the water for this tank being obtained from a lake 3,000 feet away, at which point a 250 gallon 4 inch 2-stage turbine pump, with a 20 h.p. 3-phase 550 volt induction motor directly connected to same, and operating at 1,500 r.p.m., is located. For the reception of this outfit a concrete and brick building has been erected.

Rock House Equipment.—After the skips have delivered their loads, hoisted from the mine to the grizzly, the ore falls by gravity on the spalling floor, and from there is fed into crushers, which are 30 inches x 18 inches. After passing through the crushers, the crushed ore passes through special revolving screens, the perforated plates of which are constructed of manganese steel. After passing through the screens the ore falls on the picking belts, each of which is 36 inches wide and approximately 50 feet between pulley centres. All necessary hoppers, chutes, troughing idlers, etc., are supplied for delivery of the ore into the various ore pockets provided for its reception. The cars into which the ore is finally loaded pass below these pockets, into which the ore is fed by gravity.

The power to operate each crusher, with its complement of screens and picking belts, is obtained from a 50 h.p. 3-phase 550 volt induction motor of the wound rotor type, operating at 500 r.p.m., by means of belting and shafting.

Mine Pumps.—For clearing the mines of water there have been provided special single acting, vertical, triplex, brass-fitted pumps, each having a capacity of 100 gallons per minute against a head of 250 feet, each pump being connected by gearing to a 15 h.p. 3-phase 550 volt induction motor, operating at 750 r.p.m.

Creighton Mine Sub-Station.—The sub-station at Creighton Mine is almost exactly similar to that at Crean Hill, and is connected to the second branch line from one of the two main transmission lines, this branch line being about 3 1-2 miles in length. It is of single pole construction, and has special aerial switches located at the point of departure from the main line.

The building itself, the switching and lightning arrester tower, the transformer compartment, and the switchboard arrangements are almost exactly like the corresponding items at Crean Hill, except that the three transformers have a capacity of 275 kw. each, instead of 175 kw.

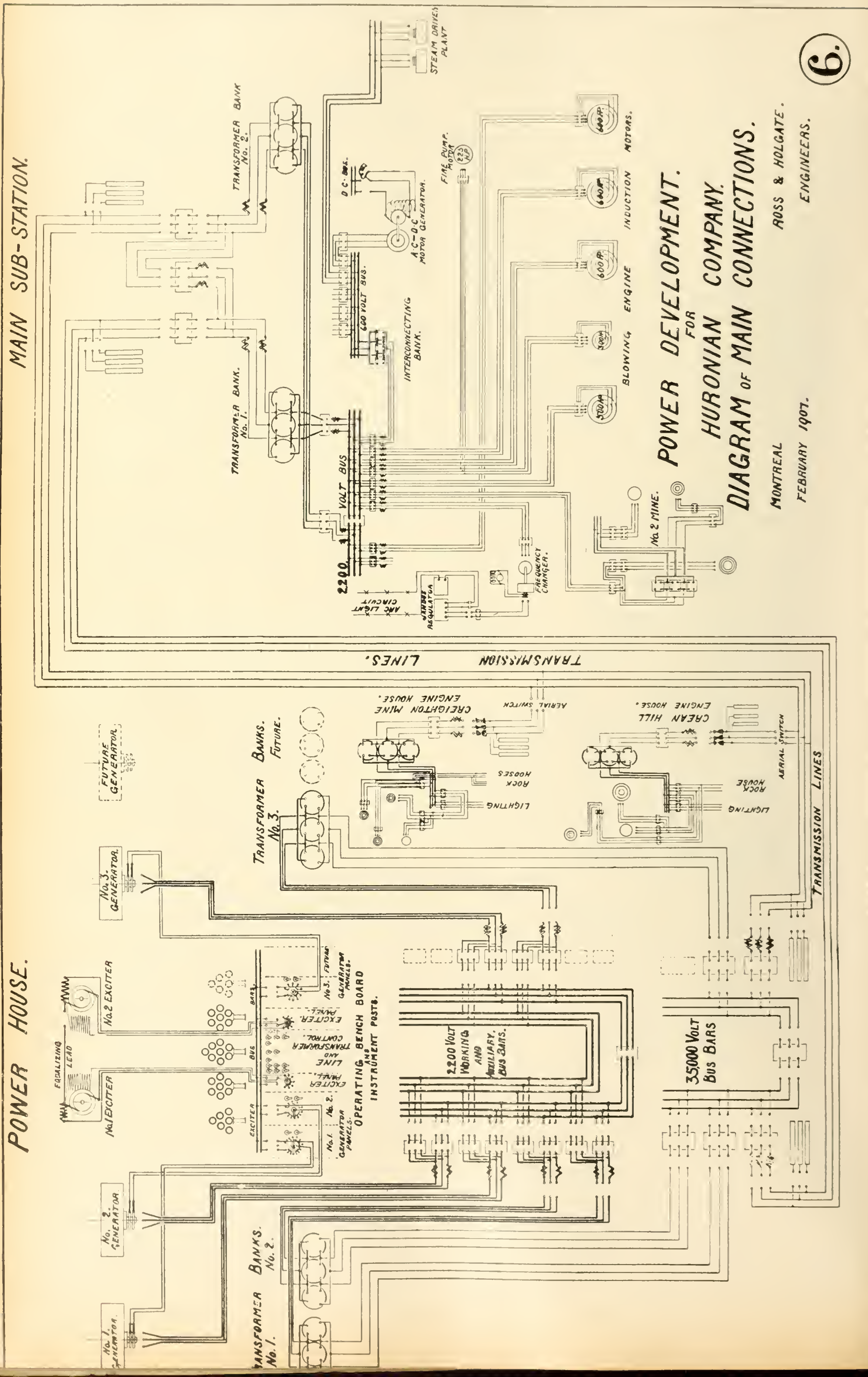
The apparatus for supplying air to the mines is the exact counterpart of the Crean Hill compressor outfit. There are two mine hoists at Creighton for handling the ore, instead of one as at the former mine.

The devices for fire protection, transformer, and compressor cooling water, and the tank and apparatus for water storage for the fire pump supply are also the same as the corresponding apparatus at Crean Hill, and the rock house equipment and the mine pumps will, when completely installed, also carry out the general idea of duplication.

No. 2 Mine Sub-Station.—No. 2 mine, situated in Copper Cliff, has its sub-station situated approximately one mile distant from the main sub-station. The building, as in the other cases, is constructed of concrete and brick, and has a similar ten-ton crane to handle its apparatus. The supply of current for all purposes is obtained directly from the main sub-station at 2,300 volts, 3-phase, 60 cycles. Part of the machinery in this building is operated at the above pressure, and part at 550 volts, the control of which is through totalling and feeder panels. Three 125 kw. transformers, oil-filled, natural-cooled, reducing from 2,300 to 550 volts, are located in a special fireproof compartment.

The air compressor apparatus is the same as those at Crean Hill and Creighton, except that the driving motor is wound for 2,300 volts.

There is installed for operating the mine skips a special double-drum hoist, arranged for the drums to operate in counterbalance or independently, and, as in the other cases, the rope speed is 500 feet per minute, and the capacity of each skip is 6,000 lbs., a similar motor to the other hoist motors being provided for its operation.


6.
POWER DEVELOPMENT.
FOR
HURONIAN COMPANY.
DIAGRAM OF MAIN CONNECTIONS.
MONTREAL
FEBRUARY 1907.
ROSS & HOLGATE.
ENGINEERS.
MAIN SUB-STATION.
POWER HOUSE.
TRANSFORMER BANK No. 1.
TRANSFORMER BANK No. 2.
STEAM DRIVEN PLANT
D.C. BUS.
A.C.-D.C. MOTOR GENERATOR.
FIRE PUMP MOTOR
600 VOLT BUS.
INTERCONNECTING BANK.
2200 VOLT BUS
BLOWING ENGINE INDUCTION MOTORS.
No. 2 MINE.
FREQUENCY CHANGER.
ARC LIGHT CIRCUIT
REGULATOR
TRANSMISSION LINES.
CREIGHTON MINE ENGINE HOUSE.
AERIAL SWITCH
ROCK HOUSES
LIGHTING
CREAN HILL ENGINE HOUSE.
ROCK HOUSE
TRANSFORMER BANKS. FUTURE.
TRANSFORMER No. 3.
FUTURE GENERATOR.
No. 3. GENERATOR.
No. 2 EXCITER
No. 1 EXCITER
EQUALIZING LEAD
EXCITER
BUS
BARS
No. 3. FUTURE GENERATOR PANELS.
EXCITER PANEL.
TRANSFORMER CONTROL.
LINE AND
EXCITER PANEL.
No. 1. No. 2. GENERATOR PANELS.
OPERATING BENCH BOARD AND INSTRUMENT POSTS.
2200 VOLT WORKING AND AUXILIARY BUS BARS.
35000 VOLT BUS BARS
No. 2. GENERATOR.
No. 1. GENERATOR.
TRANSFORMER BANKS. No. 1. No. 2.

The fire protection apparatus duplicates that installed at the other two mine sub-stations, the supply of water for the pump being obtained by tapping a 16 inch main, which supplies water to the smelter, while the water for cooling the compressor is circulated by a similar centrifugal pump to those at Crean Hill and Creighton. This applies also to the mine pumps.

For the operation of the machinery in the rock house building, a 50 h.p. 3-phase 550 volt induction

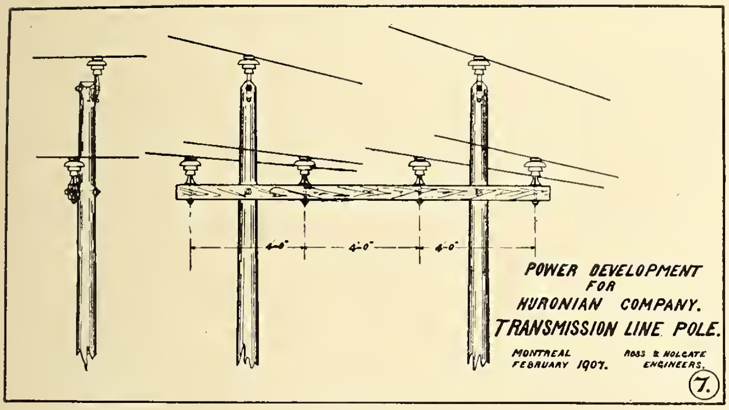


FIGURE No. 7.

motor of the wound rotor type has been installed, all connections to crusher, etc., being by belting.

THE COBALT SMELTER SUB-STATION.—This sub-station is located in Copper Cliff, and is approximately two miles distant from the main sub-station. The building is constructed of concrete and brick, and contains three 75 kw. oil-filled, natural-cooled transformers, receiving current at 2,300 volts, 3-phase, 25 cycles direct from the main sub-station and reduced to 550 volts and distributed through control and feeder panels.

In this building is also located a 1,000 gallon 6 inch 4-stage turbine fire pump, directly connected to a 150 h.p. 3-phase 550 volt induction motor, with control panel, also a dry fire line has been piped to various points throughout the plant.

The supply of water to this pump is obtained under 20 lbs. pressure from the domestic service pipes fed from the storage reservoir.

Throughout the smelter the following 3-phase 550 volt induction motors are installed:

3 50 h.p., running at 550 r.p.m.
1 35 h.p., running at 750 r.p.m.

The plant was put into operation in February, 1906.

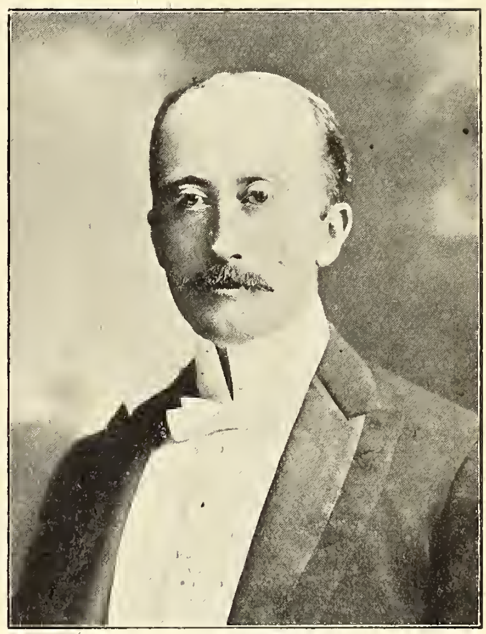
MR. J. W. CAMPBELL GOES WEST.

The electrical fraternity will learn with much regret that Mr. J. W. Campbell, manager of contract sales for the Canadian General Electric Company, Toronto, has tendered his resignation, and will hereafter be less prominently identified with the electrical business, having accepted the position of managing director of the Alberta Portland Cement Company, of Calgary.

For fifteen years Mr. Campbell has been associated with the Canadian General Electric Company, and for many years past has occupied the position of general agent. In this position he has become well and very favorably known throughout almost the entire Dominion, and the severance of this long-established connection is greatly regretted by all concerned.

Mr. Campbell's well-deserved popularity with the citizens of Toronto was attested to by the numerous functions arranged in his honor prior to his departure for the West. The Canadian General Electric and Canada Foundry Companies tendered him a farewell banquet at the King Edward Hotel on Thursday evening, April 25th. Mr. H. G. Nicholls, secretary and assistant general manager of the Canadian General Electric Company, presided, and a message was received from Mr. Frederic Nicholls, managing director, who was in Europe, expressing his warm appreciation of Mr. Campbell's services and regret at his retirement. The companies not only tendered him the banquet, but presented him with a very substantial cheque. A gold watch was also presented to him on behalf of his old friends connected with the companies, and many complimentary references were made to his genial disposition, his unswerving good nature and his keen business ability.

Although primarily devoting his attention to the manufacture of cement, Mr. Campbell will, happily, still be identified with the electrical industry, inasmuch as the Alberta Portland Cement Company will



MR. J. W. CAMPBELL.

use about 3,000 horse-power of electric power in their plant, and it is their intention to immediately undertake the development of 10,000 horse-power at a site already purchased on the Bow river.

Mr. Campbell will assume his new duties on the 15th inst., and will carry with him to the West the warmest friendship and good wishes of a wide circle of acquaintances.

The Saskatchewan Electric Company, of Regina, has recently increased its capital to $25,000. At the same time a change was made in the name, it being now known as the Saskatchewan Electric Company, Limited. The company has recently moved its headquarters into the Black Block, Scarth street, Regina, where they have larger wareroom accommodation and carry a full line of electrical apparatus. It is their intention soon to branch out into the wholesale trade also. They are general provincial agents for the Canada Lighting Fixtures, Limited, illuminated signs and Holoplaner glass. The president of the Saskatchewan Electric Company is N. S. Edgar; vice-president, J. F. L. Embury; secretary-treasurer and managing director, F. W. Logan; engineer, E. S. Harrison.

CANADIAN

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AND ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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JAS. ROBERTSON, Montreal Light, Heat and Power Co., Montreal, Que.
L. W. PRATT, Western Counties Electric Company, Brantford, Ont.
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
W. WILLIAMS, Gas & Electric Light Co., Sarnia, Ont.
LEWIS BURRAN, Quebec Railway, Light & Power Co., Quebec.
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Ash Burning.

The credulity of the general public, and, we are sorry to admit, of several well-known engineers, in connection with the ash-burning theory, is only equalled by the absolute absurdity of the proposal. It must be apparent to anyone possessing ordinary intelligence that there is no such thing in this world as something for nothing, and if the word "ash" means the residue left upon burning a combustible, it stands to reason that if there should be in such ash any material which is capable of further burning, the combustion in the first place was not carried to its limit. We must admit that in many of the so-called ash piles there is a very large percentage of unburnt coal and coke, and hence, by putting such ashes upon a bright fire, it is possible to consume that portion of the coal and coke which was not burnt on the first occasion, but there is absolutely no combustion in the true ash, nor can we by any process whatsoever, obtain heat from any substance from which all the heat has been abstracted. The secret chemical and the acetylene gas theories are mere blinds. We can burn oxalic acid, of course, but when we compare the heating power of this material, at ten cents a pound, to coal, at three or four dollars a ton, the complete extravagance of the suggestion is evident. Salt will not burn, nor will it produce combustion in other substances. The one thing which is effective in promoting the combustion of unburnt coal is plain water, which, upon application, has a tendency to wash off the fine dust with which the particles are coated. Possibly a salt solution will do this work a little better than plain water, but, as before stated, the salt itself has nothing to do with the actual combustion. It is a well-known fact that the ordinary household furnace or cook stove is very extravagant in its consumption of fuel, and that in the resultant so-called ash there is a large portion of unburnt material, hence the undesirable job of ash sifting, with, of course, its consequent saving. But there is no ash being burned. We have seen, within the past few weeks, several experiments tried in large boiler houses, and the only result was a very decided spoiling of the temper of the firemen. In one case, two parts of green coal were mixed with one of ash, and the fire, though under an excellent draft, could not be maintained. On changing the mixture to four to one, better results were obtained, though we are inclined to think four parts of green coal and one of sand would doubtless have produced about the same evaporation. While a certain amount of green coal and coked coal will drop through the grates in a boiler house, still this percentage is small, and the aggregate ash contains little or no combustible material, hence a scheme which may be used in a household furnace is not in the least applicable to a boiler room, besides having the serious drawback of a clinker-

forming propensity that is positively astonishing, not to say fatal to continuity of service. Let those who are still doubtful give the scheme a thorough trial, but we would warn our readers to break up the clinker before it has a chance to cool.

The Municipal Attitude. When a civic corporation gets, or is endeavoring to get, the upper hand, the company operating a public franchise must apparently expect a choice series of caddish and unsportsmanlike tricks, and just how the public manages to sympathize with the officials of a city who have adopted such an attitude is beyond our understanding. Fair play on all sides seems the only solution of difficulties of this nature. Without it, the companies are forced to take advantage of every loophole which is presented, in order that the scurviness of the municipality may not drive them into bankruptcy, whereas, if the contending parties would meet and in amicable discussion settle their disputes, all concerned in such controversies would certainly be better off. There are enterprises all over the world which have been put upon a successful footing through the untiring energies of their officials, and should such a concern hold a municipal franchise, the people seem to have the idea that the property on becoming remunerative should be forthwith expropriated, or, as an alternative, the revenue derived from the investment should be limited to banking interest. People do not seem to realize that prominent men associated with such enterprises are not always successful. The flotation of a big scheme carries with it a tremendous risk, and if failure is the result, the promoters take their medicine like men and bend their energies in other directions. It is of the successes that we hear, not the failures, and thousands of dollars which have been made out of one enterprise may go but a short distance in recompensing the promoters for other losses. Prosperity can only come to a country through the competence and ability of the financial leaders, and if we attempt to limit their profits to banking interest, it will not be long before a period of depression will be in evidence. Over-capitalization and stock-watering may be looked upon as evils, and, when carried to excess, undoubtedly deserve to be classified as such, but within certain limits the practice is entirely legitimate. In the daily press we see dozens of advertisements offering mining stock considerably below par, and we are often inclined to think that the capitalization stated is excessive. A mining property has a certain possible value, and should be capitalized for this amount. The men who invest their money in such an enterprise during its early stages, do so with the knowledge that there is every chance of losing all that they put into it, and hence it is only just to give them the opportunity of getting a return far in excess of their investment, or at least equal to their possible loss, should the prospective value become a reality. We believe this same reasoning is applicable to power developments, such as have been carried out in the Province of Ontario. The men who had the courage to finance these enterprises took an enormous risk, and they are therefore, in our opinion, entitled to a proportionate return in the event of success. To secure this return, over-capitalization and watering of stock is essential, but, as before stated, should be carried out within limits. When a municipality talks of expropriation, they apparently think they should acquire a property at its taxable value, whereas there is no question but that the earning power should be used as a basis. If a certain business be a success, there is no question but that such condition is due to an immense expenditure of brain energy, and the value of that energy is really represented by the so-called watered portion of the stock, and any municipality which wishes to expropriate a private corporation should pay, not only for the machinery and equipment, but for the brain work which has placed the business on a successful footing. The good sense shown by the Ontario Legislature in connection with the City of Toronto's bill of expropriation will commend itself to every public franchise company in the country, and the City's attitude and complete backdown would be ludicrous were it not for the contemptible aspect of the case. When the Legislature stated that the City might take over the plant on a proper business basis, provided they assumed all assets and liabilities of the Electric Light Company, and it was found that among such there existed a contract with the Toronto-Niagara Power Company for a long term of years, to purchase all energy at thirty-five dollars per horse-power, the apparently unquenchable ardor which had previously characterized the municipal ownership idea suddenly vanished into thin air. As per the statement of our esteemed contemporary, the Montreal Gazette, much of what has passed for the beauty of the hydro-electric proposition is being rubbed off, and Toronto is, we regret to note, stigmatized with the unenviable title "the centre of Socialistic brainstorms".

CANADIAN ELECTRICAL ASSOCIATION CONVENTION AND ELECTRICAL EXHIBITION.

In September next the City of Montreal will attract the electrical fraternity from all parts. The Canadian Electrical Exhibition Company are rapidly completing arrangements for an electrical exhibition which promises to surpass anything of the kind heretofore attempted in this country. This exhibition will be held in the Government Drill Hall, on Craig street, opposite the City Hall and Court buildings, and will commence Monday, September 2nd, and continue for two weeks. The building in which the exhibition will be held has 32,000 square feet of space and is splendidly adapted for the purpose. The directors have already received many applications for space, not only from Canada and the United States, but also from France and England, and there is every reason to believe that the exhibition will be a gigantic success. We understand that several of the companies purpose making quite elaborate exhibits. The directors of the Canadian Electrical Exhibition Company are Messrs. W. McLea Walbank, R. S. Kelsch, J. W. Pilcher, H. D. Bayne, and James A. Milne.

The Canadian Electrical Association has decided to hold the annual convention in Montreal while the exhibition is in progress. The dates selected are Wednesday, Thursday and Friday, September 11th, 12th and 13th. This convention promises to be of unusual interest. Mr. Dion has the question box in hand, which ensures its success, but it is hoped that it will be loyally supported by all the members.

Internal Combustion Engines*

By R. A. Fraser.

Introduction.

When your Mr. Black invited me to give a short paper on gasolene engines, or more correctly termed internal combustion engines, which covers both gas and gasolene engines, and in fact all engines operating on gaseous fuels, I agreed to do so with a good deal of reluctance, realizing that in a society such as yours there must necessarily be many members better qualified to handle the subject than I am, particularly when dealing with it from a theoretical and technical point of view. However, having agreed to address you on the subject, I hope to deal with it in a more or less popular way, and, while some of the matter may be somewhat elementary, I hope that on the whole it may prove at least interesting.

It is a remarkable fact that the internal combustion engine combines within itself all the functions which in a steam plant call for a steam engine, boiler, feed pump, smoke stack, and the services of a man to operate it. Not only so, but when we stop to consider that the gasolene engine when applied to a motor cycle, the entire outfit, weighing little over one hundred pounds, is capable of carrying a man weighing two hundred pounds for over one hundred miles on a consumption of one gallon of gasolene, we see the possibilities of this form of power as a means of cheap transportation. I will go further, and state that it must be evident to those of us who take an interest in matters mechanical that if the solution of mechanical flight is ever to be attained the gasolene engines promises to play an important part in the solution of this problem. It, therefore, behooves us to learn something of this power which has revolutionized transportation, and bids fair to revolutionize industrial life. The subject is a large one, and it is, of course, impossible to discuss it in all its phases within the limited time at my disposal. I have, therefore, thought it well, in order to deal with the subject in as concise a manner as possible, to divide the paper under four general heads, namely,—

(a) Theory of operation;

(b) Fuels;

(c) Types of engines;

(d) Mechanical construction.

Theory of Operation.

I take it that most of us are familiar with the fact that to the German inventor, Dr. Otto, is due the credit for developing the internal combustion engine as a commercial possibility, and, despite the great advance made in gas engines since that time, the Otto cycle as first developed by Dr. Otto still stands. Of course, many experiments in gas engines were carried out before his time, but he was the first to appreciate the importance of a definite cycle of operation, and, particularly, the necessity of a definite exhaust phase, and thus get rid of the exhaust gases so as to produce a commercial and economical engine without utilizing outside means for scafenging the exhaust. It is a striking tribute to the efficiency of the gas engine that, while only one stroke out of four is the working stroke, or, putting it another way, three parts of the engine's time is wasted, yet in the face of this fearful handicap the gas engine bids fair to beat all rivals in the economical generation of power.

The four operations which go to make up the cycle are:—

(1) Suction.

(2) Compression.

(3) Ignition.

(4) Exhaust.

In the four cycle engine, which is the type in most common use, it takes four strokes of the piston, or two revolutions of the shaft, to complete the cycle, only one stroke being the working stroke, the remaining three strokes being taken care of by the momentum, or energy, stored up in the flywheels. Right at this point is where some confusion frequently arises in the minds of those not familiar with the operation of the gas engine, and where it is made to suffer in comparison with its rival, the steam engine, since in the case of the steam engine only two functions are carried out in the cylinder, that is, the admission and the exhaust of the steam, the preparation and admission of the fuel being provided for, apart from the engine, by the wasteful and dangerous agency of the steam boiler. It is really the failure to grasp the simplicity of the principle on which the internal combustion engine operates that we so commonly hear the statement about as follows:—

"Well, gas engines are queer things anyway: when they run, you don't know why they run, and when they stop, you don't know why they stop."

As a matter of fact, nothing could be more absurd than a statement of this nature, and, in order to realize this, it is only necessary to recall what constitutes the four factors which go to complete the cycle, and, remembering these, to state that, provided an engine draws in a full and proper charge, provided that charge is properly compressed, fully ignited, and freely exhautsed, then no matter how crude the design may be, how indifferent the materials, and how poor the workmanship, that engine will run and continue to run until one of the functions fails which go to make up the cycle. It is impossible to lay too much stress upon this aspect of the matter, as it lies at the very root of the subject, and a proper appreciation and understanding of this fact would save much mental research and often a good deal of physical exercise expended in a vain endeavor to start up an engine by turning over the flywheel, the engine having stopped and refusing to start, apparently for no good reason, but, as a matter of fact, necessarily through the failure of one of the functions of a cycle to carry out its part.

With the aid of the sectional model before us, we can look into the operation of the four factors which go to make up the cycle. Starting with the piston at the top of the cylinder, as it descends a vacuum is created, causing the inlet valve to open automatically, admitting the mixture of gasolene and air. This mixture continues to flow in until the piston reaches the end of the first down stroke. The inlet valve then closes automatically by the tension on the spring, thus confining the charge in the cylinder.

The return stroke, known as the compression stroke, is brought about by the momentum of the flywheel, and compresses the charge. This is essential, in order to obtain proper ignition of the charge, and to obtain power and economy from the engine. In a general way, and within limits, the higher the compression, the greater the power. The amount of compression, however, it is desirable to have is, of course, limited, as, if excessively high compression is carried, there is a tendency to ignite the charge prematurely, setting up very severe stresses in the engine, causing it to work very irregularly. The best accepted practice is to carry a moderate compression of from fifty to eighty pounds, on gasolene, up to as high as 175 pounds on producer gas. In gasolene engines, the larger the engine the lower the compression. The faster the engine, the higher the compression may be in producer gas.

The third stroke in the cycle is the working stroke, obtained from the ignition, or explosion, of the charge, or, put more correctly, due to the rapid expansion of the charge. It is important to note carefully the point at which the ignition of the charge should take place, so as to get the maximum power from the engine. At first glance, the natural inference would be that ignition should take place just as the crank passes the top centre, and when it is stated that the ignition must take place when the crank pin is about fifteen degrees behind the top centre, the natural conclusion would be that the tendency would be to drive the engine in the opposite direction. In practice, however, this is not so, and to get the greatest power from the engine the igniter has to be tripped somewhere around this point. The explanation of this is that there is an interval of time which elapses between the time the igniter trips, causing a spark at the point and before fully igniting the charge, and by tripping the igniter ahead of the crank the greatest force is given the piston just as it passes the top center. I may point out that we frequently hear of the internal combustion engine, referred to as explosion engines, and in speaking of the ignition of the charge

*Paper read before the Engineers' Club of Toronto, April 18th, 1907.

we generally speak of it as an "explosion." Explosion engines were at one time in use, and some small ones are possibly still employed, but to speak of the internal combustion engine as an explosion engine is entirely erroneous, and the fact that ignition has to take place so early in order to obtain full advantage of its force proves it, as what actually does take place is rapid ignition and expansion. The distinction is, perhaps, a fine one, but, as a matter of policy, especially in describing the engine to people who are not familiar with the operation of the engine, and, naturally, somewhat suspicious of gasolene, it is well to avoid the use of the word "explosion," substituting ignition and speaking of the third operation as "the working stroke." The fourth operation in the cycle is the exhaust stroke, the exhaust valve being mechanically opened at the end of the working stroke, and remaining open until the piston has reached the top, being carried up by the momentum, stored up in the flywheel, driving out the burned products preparatory to drawing in a fresh charge, and this completing the cycle.

Fuels.

In considering the fuels in general use in connection with the internal combustion engine, we may subdivide this general head under three subsidiary heads:—

(a) Classes of fuels.
(b) Heat value of fuels.
(c) Consumption of fuels.

The fuels in general use are either gasolene, kerosene, crude oil, illuminating gas, natural gas, producer gas and alcohol. Gasolene, which is the fuel in most common use, and is one of the fluids obtained from distilling crude oil, is classified under two heads, known to the trade as "engine gasolene of 76 degrees" and "stove gasolene of 67 degrees." Chemically, gasolene is a compound of carbone and hydrogen, or a mixture of several similar compounds. This in a state of vapor or gas is mixed with air, consisting of one part oxygen and four parts of nitrogen. The hydrogen and carbon in the gasolene combine with the oxygen, forming carbon dioxide and water, leaving the inert nitrogen as before.

Kerosene is also one of the fluids obtained from distilling crude oil, and is a lower grade than gasolene. It differs from gasolene in so far that it is not explosive, and will not give off vapor when exposed to air, as gasolene will, but on the other hand it can be readily vaporized. The advantages in the use of kerosene for an engine are that in some sections it is more easily obtained; it is usually cheaper; and it is always possible to get a lower rates of insurance where a kerosene engine is installed. The disadvantages of a kerosene engine are that the engine is somewhat more complicated, and in the hands of an inexperienced person there is a greater likelihood of the engine giving more or less trouble, compared with a gasolene engine.

The use of crude oil has not, so far, become general, as it calls for a special type of engine. The failure of the early engineers to make this type of engine work was due to the fact that they did not compress the air high enough before heating commenced by the fuel, and also to the mixing of air and fuel before entering the working cylinder. The mixed fuel and air could not safely be compressed to any high degree. Siemens made the first successful engine of this type, compressing the air and fuel separately, and injecting the fuel as the piston moved out. Diesel does the same thing: hence compression as high as four hundred pounds per square inch or more can be employed, and the temperature of compression is high enough to burn any kind of heavy oil of the crudest quality by self-ignition. The constant pressure of four hundred pounds, together with the liability of further sudden rise in pressure, this, coupled with the weakening effect on the metal, due to the high temperature, which varies within wide ranges, tends to scare probable users, and make engineers go cautiously, as one or two disastrous accidents to engines using this fuel would indicate that handling this type is a little bit in the nature of "monkeying with gunpowder."

Illuminating gas, while an excellent fuel, is, of course, only available in the cities and large towns, and natural gas, while it is, perhaps, the best of all fuels, is only found in certain sections of the country.

Producer gas, which is coming to the front so rapidly in this country as a power gas, is obtained from the products of combustion of what is termed "pea anthracite" coal, combined with the vapor from water, together with a certain quantity of air. A discussion of the operation and the possibilities of the producer gas system would have to be made the subject of a paper by itself, and is altogether too comprehensive to deal with within the scope of this paper. I would simply express my personal conviction that in this country we have only touched the fringe of the development of this form of power, and, while we have heard a great deal lately as to the advantages of Niagara power—particularly in this section—I wish to put myself on record by stating that I believe it will be found eventually impossible to compete with producer gas, as it is important to note that there is no known fuel, not already in a gaseous form, that may not be converted into gas through the agency of the producer, and if we are to follow the experiments already being made in some of the older countries, it is only a question of time when the garbage gathered from the streets of our large cities, the waste products from many of our large industries, that at the present time is going to waste, or costing many thousands of dollars to get rid of, will be converted into useful energy for the distribution of power and light at a very low cost.

(To be continued in June issue.)

IRON PAINTING SCIENTIFICALLY CONSIDERED.

There are many causes of the rusting of iron. It may be produced by atmospheric action alone, but in a majority of cases galvanism plays a large part in the destruction of the metal. Long experience has shown how rapidly iron nails employed in fastening sheets of lead and copper upon roofs are destroyed, the other, the electro-negative metal, remaining comparatively unaffected. The electrolyte, or exciting fluid, which by acting on the iron and not on the other metal or by acting more upon the former than upon the latter, causes the electric current, is either actual water from rain or snow or the water vapor always present in the atmosphere. The decomposition of the water causes the liberation of oxygen at the positive pole, which is the iron, and this nascent oxygen rapidly combines with the iron. Now, it is claimed that red lead is an excellent material for protecting iron from rust and electrical action. Unfortunately, however, red lead is more electro-negative to iron than either copper or lead. Hence, should moisture by any chance get between the red lead and the iron, the destruction by rust is more rapid than when iron is in contact with copper or lead. This electro-chemical action is at the same time strengthened by the purely chemical action between the red lead and the carbonic acid always present in the air, an action which converts the red lead into ceruse, whereby an additional quantity of nascent oxygen is set free to rust the iron. It is also highly probable that the carbonic acid has an independent action upon the iron, thereby much facilitating its oxidation. It must not be forgotten that every porous place and still more every crack in the paint becomes sooner or later an entrance for water and carbonic acid. A good oil varnish is by far the best protection for iron, but it must, of course, be properly used. Not only must the iron be scrupulously, practically and chemically clean and dry when the varnish is applied, but the covering must be without a flaw. Varnish will not adhere to greasy, rusty, or wet iron, and the contraction of the varnish on drying will cause minute cracks at such places and the iron-destroying gases will find their way through these cracks and get between the iron and the non-adherent varnish. Again, the varnish must be thoroughly dry before the iron is exposed to the weather. The varnish may be colored if the color does not interfere with the strength, continuity and elasticity of the protecting skin, but is best dispensed with.—Architectural Art.

The Berlin Electric Manufacturing Company had an interesting exhibit at the Automobile and Sportsman Exhibition, held at Montreal, April 6th to 13th. A feature of their exhibit was the largest dry cell battery ever made, and which was the subject of a guessing contest as to its amperage, the successful contestant to receive one barrel of dry batteries. The McGill students were particularly interested. The amperage was 422. The exhibit was under the direction of Mr. E. D. Brand, manager of the company, assisted by Mr. A. G. Crysdale.

The Electricity Inspection Act

As Passed by the Dominion Parliament March 7, 1907.

Important amendments were made to the Electricity Inspection Act before it was finally passed by the Dominion Parliament on March 7th last. The bill as revised is, therefore, printed herewith:

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

SHORT TITLE.

1. This Act may be cited as The Electricity Inspection Act, 1907.

INTERPRETATION.

2. In this Act, unless the context otherwise requires,—
   (a) "contractor" means any person undertaking to furnish electricity to any purchaser for lighting or other purposes;
   (b) "purchaser" means any person to whom electricity is furnished;
   (c) "meter" means an electric meter, and includes every kind of machine, apparatus, or instrument used for measuring the quantity of electrical energy or pressure furnished to the purchaser;
   (d) "purchaser's terminals" means the ends of the electric lines or conductors situate upon the purchaser's premises at which the supply of electricity is delivered from the service lines;
   (e) "Department" means the Department of Inland Revenue;
   (f) "Minister" means the Minister of Inland Revenue;
   (g) "inspector means an inspector appointed under this Act by the Department;
   (h) "frequency" means the number of complete periods or cycles per second of the alternating current.

UNIT OF SUPPLY.

3. The commercial unit of supply of electrical energy shall be one thousand watt-hours, or the equivalent thereof in ampere-hours at the stated voltage.

4. Before commencing to give a supply of electrical energy to any purchaser for lighting purposes the contractor shall declare in writing under his hand, to such purchaser, the constant pressure, and if from an alternating current source, the frequency at which he proposes to supply energy at the purchaser's terminals.

(2) The variation of pressure, and in the case of alternating currents the frequency, at any purchaser's terminals, shall not under any conditions of the supply which the purchaser is entitled to receive, nor at any time, exceed 4 per cent. from the declared constant pressure or frequency, whether such variation is due to the resistance of the service lines or apparatus belonging to the contractor, or to any action or effect produced by such apparatus, for which the purchaser cannot be shown to be responsible, or partly to a variation of pressure in the distributing mains from which the supply is taken.

(3) The contractor shall not be liable for any variation of pressure caused by unavoidable accident to the generating plant or apparatus, or by the uncontrollable condition of the elements.

5. The contractor shall be responsible for all electric lines, fittings and apparatus, belonging to him or under his control upon the purchaser's premises, being maintained in a proper condition, and in all respects fit for supplying energy; but he shall not be responsible for any damages arising from the use of the electric current in lines, fittings and apparatus not belonging to him or under his control.

6. If the contractor is reasonably satisfied, after making all proper examination by testing or otherwise, that at some part of a circuit a connection with the earth exists of such resistance as to be a source of leakage, and that such connection does not exist at any part of the circuit belonging to the contractor, any officer of the contractor, duly authorized by him in writing, may, for the purpose of discovering whether such connection with the earth exists at any part of the wires upon any purchaser's premises, at all reasonable times, after giving one hour's notice of his intention to do so, enter such premises and disconnect the purchaser's wires from the service lines, and may require the purchaser to permit him to inspect and test the wires and fittings belonging to the purchaser and forming part of the circuit.

7. If, on such inspection and testing, the officer discovers that a connection exists between the purchaser's wires and the earth, and that such connection has an electrical resistance of less than five thousand ohms, or if the purchaser does not give all due facilities for such inspection and testing, the contractor shall forthwith discontinue the supply of energy to his premises, giving immediate notice of such discontinuance to the purchaser, and shall not recommence such supply until he is satisfied that such connection with the earth has been removed.

8. If any purchaser is dissatisfied with the action of the contractor, either as to the mode of making the test or in discontinuing the supply of electricity to his premises, the wires and fittings of such purchaser may, on his application to the Department, be tested, for the existence of such connection with the earth, by an inspector.

9. Any officer of the contractors authorized in writing by the inspector may, for the purpose of,—
   (a) inspecting their electric wires, meters, accumulators, fittings, works, and apparatus for the supply of electricity; or
   (b) ascertaining the quantity of electricity consumed or supplied; or
   (c) removing any electric wires, meters, accumulators, fittings, works and apparatus belonging to the contractors; or
   (d) in cases where a supply of electricity is no longer required or the contractors are authorized to take away and cut off the supply of electricity from any premises, doing as little damage thereby as may be,

enter at all reasonable times any premises to which electricity is or has been supplied by the contractors.

(2) Such officer shall repair all damage caused by such entry, inspection or removal.

10. Before supplying electricity to purchasers, the contractor shall obtain from the Department, or from an officer appointed for the purpose, a certificate of registration for every generating plant owned or operated by the contractor in any city, town, village or other municipality, and shall pay the officer issuing such certificate the fees prescribed by the Governor in Council.

(2) Such certificate shall expire on the thirty-first day of March in each year, and shall be renewable from year to year.

OFFICERS.

11. The Governor in Council may appoint for the purposes of this Act an Electrical Expert, to be known as the Chief Electrical Engineer, together with such assistants as the Head of the Department may from time to time deem necessary. The Chief Electrical Engineer shall, under the direction of the Minister of Inland Revenue, have the custody of the standards of electrical measure, shall conduct all comparisons, verifications and other operations in respect of such standards and other electrical measuring instruments, and shall have the general supervision and direction of the work of electric inspection throughout Canada.

(2) No person shall be appointed to act as inspector or assistant inspector until he has passed a qualifying examination in electricity, such examination to be held by a board of three examiners, composed of the Chief Electrical Engineer of the Department, who shall preside, and two electrical experts to be appointed by the Governor in Council. Nothing herein contained shall affect the position or status of any officer appointed prior to the passing of this Act.

(3) Graduates in electrical engineering of any university in Canada may be appointed without passing the qualifying examination.

(4) No inspector shall be a seller of electricity or electric meters, or be employed by any person supplying electricity or meters.

METERS.

12. The amount of electrical energy supplied by a contractor to any purchaser under this Act, or the electrical quantity contained in such supply, shall, if the purchaser so desires, be ascertained by means of a suitable meter, duly certified in accordance with regulations established under the authority of this Act.

(2) Whenever a reading of a meter is taken by the contractor for the purpose of establishing a charge upon the purchaser, the contractor shall cause a duplicate of such reading to be left with the purchaser.

13. No electric meter shall be admitted to verification in Canada until it has received the approval of the Department.''

(2) No meter shall be fixed for use which has not been verified and stamped as hereinafter provided.

(3) No meter, after it has been fixed for use, shall be verified or stamped by any person except by the inspector, as herein provided.

14. No meter shall be fixed for use unless it plainly indicates by means of suitable dials the amount of current or energy passing to the purchaser's wires.

(2) Every meter fixed for use shall have the maker's number, the maximum current in amperes, the limits of pressure, and, if for alternating currents, the limits of frequency of alternations, legibly stamped or engraved on the case or dial.

15. No meter shall be stamped which is found by the inspector to register quantities varying from the legal standard of electricity more than three per cent. in favor of either the contractor or the purchaser.

16. The verification of each meter shall be attested by affixing or impressing, on some essential part thereof, a stamp or mark of such description and in such manner as is directed by regulations made by the Minister.

17. Within twelve months after the expiration of five years from such verification and stamping, every meter shall again be verified and stamped.

18. No meter duly stamped as aforesaid shall be liable to be re-verified or re-stamped within a period of five years from the then last verification or re-verification thereof, unless found incorrect under this Act, or requiring re-verification by lapse of time as aforesaid.

(2) The purchaser or the contractor may, at any time, at the cost of the party in fault, require the verification of the meter used.

(3) In the event of an inspected meter being found, on re-inspection, to vary from the standard, the contractor or the purchaser, as the case may be, shall only be entitled, in estimating any rebate, to the gain or loss, as the case may be, which has taken place during the three months immediately prior to such re-inspection.

19. Every purchaser may own and use, for determining the amount of electrical energy consumed, any meter which has been verified and stamped as aforesaid.

20. In every case the owner shall keep the meter in good repair, and shall be responsible for the due inspection and testing thereof, and, except as herein otherwise provided, shall pay the fee lawfully chargeable for such inspection, and shall be liable for all penalties incurred with respect to such meter.

21. The verification and testing of meters shall be performed in accordance with the provisions of this Act and with such further regulations, not inconsistent therewith, as are made by the Minister.

22. The contractor shall provide electricity and wiring and all other reasonable facilities for testing, free of charge, at such places as are agreed upon between the contractor and the Department.

23. If any dispute arises between the contractor and the purchaser or between the contractor and the inspector, respecting the correctness of such meter, the inspector shall, if required by any person dissatisfied, refer such dispute to the Department for final decision.

(2) During the testing of any disputed meter, the contractor or purchaser may be present, by himself or his agent authorized in writing; and twenty-four hours' notice of the test shall be given by the inspector to both the parties interested.

GENERAL.

24. The purchaser may at any time, on payment of a fee to be fixed by the Governor in Council, call on an inspector to test the pressure of the electricity supplied by the contractor, and to furnish a certificate thereof.

25. The inspector shall give to either the contractor or the purchaser, or to both, on payment of the proper fee, a certificate stating the result of his test, and the time at which it was made, and at whose instance, and any other particulars he thinks right to insert for the information and guidance of the persons concerned.

(2) Such certificate shall be prima facie evidence of the condition of the meter or electrical pressure tested, and when more such certificates than one are issued, the proper fee shall be paid upon each certificate.

26. The contractor shall at all times keep in his office, in a book or books, the names and addresses of purchasers for the time being—which book or books shall be open to the inspector during office hours, and from which he may take such extracts as he thinks fit.

27. The fees for the inspection and testing of purchasers' wires and the testing of lamps and meters and other electrical instruments and appliances shall be determined from time to time by the Governor in Council and published in The Canada Gazette, and such fees shall be regulated so that they will, as nearly as may be, meet the cost of carrying this Act into effect; and all fees received under this Act shall be accounted for and paid to the Minister of Finance and Receiver-General and in such manner as the Minister directs, and shall form part of the Consolidated Revenue Fund of Canada.

28. The Governor in Council may from time to time direct stamps to be prepared for the purposes of this Act, bearing such device as he thinks proper, and may defray the cost thereof out of any unappropriated moneys forming part of the Consolidated Revenue Fund of Canada.

(2) The device on such stamps shall express the value thereof, that is to say, the sum at which they shall be reckoned in payment of the fees hereby prescribed.

29. Separate accounts shall be kept of all expenditures incurred and of all fees and duties collected and received under the authority of this Act; and a correct statement thereof, up to the thirty-first day of March then last past, shall be yearly laid before Parilament within the first fifteen days of the then next session thereof.

OFFENCES AND PENALTIES.

30. Every contractor who makes default in complying with any requirement, as to supply, of sections 4 to 10, both inclusive, of this Act, shall be liable for every such default to a penalty not exceeding twenty dollars for every day during which such default continues.

31. Every contractor who fails at any time to keep in his office a book or books, the names and addresses of the purchasers using meters, for the time being open to an inspector during office hours, from which the inspector may take such extracts as he thinks fit, shall incur a penalty of fifty dollars.

32. Every person who, except under the authority of this Act, makes, causes or procures to be made, or knowingly acts or assists in making, or who forges or counterfeits, or causes or procures to be forged or counterfeited, or knowingly acts or assists in the forging or counterfeiting any stamp or mark used for the stamping or marking of any meter under this Act, shall incur a penalty not exceeding two hundred dollars and not less than fifty dollars.

(2) Every person who knowingly sells, utters or disposes of, lets, lends or exposes for sale, any meter with such forged stamp or mark thereon, shall, for every such offence, incur a penalty not exceeding two hundred dollars and not less than twenty dollars.

(3) All meters having on them such forged or counterfeited stamps or marks shall be forfeited and destroyed.

33. Every person who knowingly repairs or alters, or causes to be repaired or altered, or knowingly tampers with or does any other act in relation to any stamped meter or to the wires leading to the meters so as to cause such meter to register wrongly, or who prevents, or refuses lawful access to any meter

in his possession or control, or obstructs or hinders any inspection or testing authorized by this Act, shall incur a penalty not exceeding one hundred dollars and not less than fifty dollars, and shall pay the fees for removing and testing, and the expense of purchasing and fixing a new meter.

(2) The payment of any such penalty shall not exempt the person paying it from liability to indictment or other proceeding to which he would otherwise be liable, or deprive any other person of the right to recover damages against such person for any loss or injury sustained by such act or default.

34. Every person who knowingly fixes for use, or causes to be fixed for use, any meter, before it has been verified and stamped as herein required, shall incur a penalty of twenty-five dollars for every such unverified or unstamped meter.

35. Every person, other than the inspector, who, when the accuracy of any meter which has been verified and sealed under this Act is in dispute, wilfully breaks or causes to be broken the seal of that meter, shall incur a penalty of twenty-five dollars for every such offence.

(2) The contractor, however, after giving the purchaser twenty-four hours' notice, in writing, of his intention so to do, may break the seal of an undisputed meter when it is found necessary to disconnect such meter from the service line for readjustment or repairs.

36. Every inspector who stamps any meter without duly testing and finding it correct, or who refuses or neglects, without lawful excuse, for three days after being required under the provisions of this Act, to test any meter, or to stamp any meter found correct on being so tested, or who neglects to perform any duty imposed upon him by this Act, or by any regulations made under the authority thereof, shall incur a penalty not exceeding fifty dollars and not less than ten dollars, and shall be liable to dismissal from office.

37. Every person, except the inspector as herein provided, who verifies or stamps, or causes to be verified or stamped, or who issues a certificate as to the accuracy or condition of any meter after it has been fixed for use shall incur a penalty of twenty-five dollars for every meter so verified.

38. Every person who violates any of the provisions of this Act, or of any regulations established under this Act, or who neglects any duty imposed on him by this Act, or by any such regulation, for which violation or neglect no penalty is specially herein provided, shall incur a penalty of not more than one hundred dollars.

PROCEDURE.

39. All penalties imposed by this Act or by any regulations made thereunder shall be recoverable on summary conviction with costs,—

(a) if the penalty does not exceed twenty dollars, before any justice of the peace for the district, county or place in which the offence was committed; and,

(b) if the penalty exceeds twenty dollars, before any two justices of the peace.

(2) Such penalties may, if not forthwith paid, be levied by warrant under the hand and seal of the convicting justice or justices, who may award any imprisonment to which the offender is liable.

(3) When the offender is a corporation any process or other paper required by Par XV. of the Criminal Code to be served upon the defendant in proceedings under that Part may in such case be served upon the mayor, or chief officer of such corporation, or upon the clerk or secretary thereof.

40. No action or prosecution shall be brought against any person for any fine or penalty under this Act, unless it is commenced within six months after the offence is committed.

41. The Governor in Council may establish rules and regulations—

(a) for the testing of electric light lamps for illuminating power;

(b) for instituting tests to determine what style or make of meter shall be used to measure the quantity of electrical energy supplied;

(c) for determining a standard or standards for arc lighting; and

(d) such other regulations, not inconsistent with this Act, as are necessary for giving effect to its provisions and for declaring its true intent and meaning in all cases of doubt.

REPEAL.

42. The Electric Light Inspection Act, chapter 88 of the Revised Statutes, 1906, is hereby repealed.

NIAGARA POWER FOR MUNICIPALITIES.

The terms of a contract for a supply of power amply sufficient to fulfill the requirements of those municipalities which have applied up to date, and with provisions for any future demand, have been agreed upon between the Hydro-Electric Power Commission and the Ontario Power Company, with the exception of a few minor details. The contract has, of course, the approval of the Cabinet.

The contract will call for an amount up to 25,000 at a rate of $10.40 per horse-power per annum, 24 hours a day during the whole 365. If that amount is exceeded, then the price of the whole power delivered is brought down to $10 a horse-powr.

The following are among the more important provisions of the contract:

A minimum amount of 10,000 horse-power to be taken, the Commission to have the right to increase this at any time to 30,000 on giving thirty days' notice, and to secure a still larger supply on notice, the time of which will be specifically stated in the agreement. The price to be as stated in the foregoing.

The duration of the contract to be for ten years, with the option of renewal for 40 years, or as long as the existing agreements betwee the company and the Niagara Falls Park Commission remain in force.

The current is to be alternating, three-phase, 25 cycle, 60,000 volts at the transformer station.

Continuity of service to be guaranteed under certain penalties.

The agreed amount of power is to be kept available for the use of the Commission at all times.

Not less than three-quarters of the amount of power contracted for is to be paid for by monthly payments. A condition in this connection is that in case the actual amount taken exceeds the three-quarters, then the basis of payment shall be the gross amount taken for a specified twenty consecutive minutes during the month.

The power is to be measured by standard instruments, sealed and inspected by the representatives of the contracting parties.

Finally, there is a clause vesting in the Commission the right to purchase power from other parties, the amount of which and the territory to be served thereby have not been settled, and will not be, of course, until further demands now being made on the Commission for the supply of power, but not yet put in concrete form, assume that shape.

It is understood the Commission will shortly call for tenders for the erection of poles and the supplying and stringing of wires for transmission lines from Niagara Falls and also for the construction of transformer stations.

The contract for supplying the Light, Heat and Power Committee of Kingston with electric meters and transformers required during the year 1907 has been awarded to the Canadian General Electric Company.

What will undoubtedly be the largest installation of steam superheaters in Canada up to date is that contracted for by the Dominion Iron & Steel Company, Sydney, N.S., viz., thirty "Foster" superheaters, to be placed under eighteen Babcock & Wilcox type, and twelve Cahall type boilers of 250 h.p. each, a total of 7,500 h.p. This order was placed in the hands of Messrs. Laurie & Lamb, of Montreal.

SUCCESSFUL SCHOOL OF SCIENCE STUDENTS.

The names of the successful candidates in the recent examinations at the School of Practical Science, Toronto, have just been given out. The list is a long one, showing to what proportions the classes have grown. The result in the post-graduate course and in electrical and mechanical engineering is given below:—

FOURTH YEAR B.A. SC.

Honors—E. W. Banting, H. H. Betts, W. A. M. Cooke, N. P. F. Death, W. Maclachlan. A. W. McConnell, J. M. Menzies, W. P. Near, H. E. Rothwell. Pass—J. C. Amer, M. H. Baker, M. Bates, H. E. Brandon, M. E. Brian, A. E. K. Bunnell, E. L. Cousins (aggr.), W. N. Daniels, C. S. Dundass, W. S. Guest, C. B. Hamilton, J. C. Hartney, S. Hett, R. H. Hopkins, C. Johnston, G. R. Jones, T. Jones, A. E. Jupp, J. L. Lang, K. A. Mackenzie, B. F. Mitchell, W. G. Nicklin, D. G. Park, W. B. Porte, R. C. Purser, N. B. Robertson, C. H. Rogers, O. Rolfson, R. C. Ross, J. E. Thompson, W. H. Young.

THIRD YEAR PRIZES.

Mechanical Engineering, first prize—H. O. Hill, donor Standard Silver Company.

Electrical Engineering, first price—F. R. Ewart, donor Noel Marshall.

Mechanical and Electrical Engineering, second prize—H. Raine, donor Standard Silver Company.

MECHANICAL AND ELECTRICAL ENGINEERING.

First year—Honors—E. G. Arnes, R. A. Campbell, H. A. Cooch, W. E. Corman, T. H. Crosby, R. H. Cunningham, A. T. Ferguson, F. T. Fletcher, C. C. Flynn, A. D. Grant, C. J. Harper, J. Hemphill, C. R. Holmes, C. Hughes, H. Irwin, G. R. Jardine, J. B. O. Kemp, W. R, Key, C. B. Langmuir, A. E. Lennox, C. R. McCollum, A. A. McCordick, J. E. McDougal, A. V. Manson, L. S. Odell, W. M. Philip, L. T. Rutledge, R. A. Sara, A. Schlarbaum, C. E. Schwenger, F. C. White, L. Z. Wilson. Pass—J. N. Agnew, W. H. Barry, E. R. Birchard, W. D. Black, F. J. Blair, C. Blizard, G. H. Bowen, J. Burns, W. M. Carlyle, R. B. Cockburn, N. S. Cumming, C. N. Danks, H. W. Davis, W. P. Derham, G. A. Fargey, T. E. Freeman, E. R. Frost, M. B. Glazier, H. C. Goodling, V. F. Gourlay, F. G. Hagerman, F. C. Hatch, A. Hill, A. E. Holmes, J. Isbister, F. P. Jackes, E. A. Jamieson, T. H. Kettle, A. W. Lamont, D. D. McAlpine, R. J. McCuaig, W. G. Mackintosh, J. B. Macdonald, E. D. McFarlane, J. MacLean, N. H. Manning, P. E. Mills, G. Morton, J. C. Nash, E. H. Niebel, C. J. Porter, G. B. Rose, I. S. Rudy, M. W. Sparling, J. D. Stewart, S. Stroud, K. B. Sylvester, E. A. Thompson, C. W. Train, A. G. Trees, W. G. Turnbull, A. R. Whitelaw, G. Woodley.

Second year—Honors—O. F. Adams, S. E. Annis, P. H. Buchan, H. Coyne, G. S. Gear, C. L. Gulley, A. N. Hunter, L. N. M. Leslie, G. McLeod, F. H. Moody, W. P. Murray, N. H. Reesor, J. W. R. Taylor, V. C. Thomas, B. Waugh, F. D. Wilson, R. Young. Pass—H. T. Acres, L. F. Allen, H. V. Armstrong, H. C. Barber, R. D. S. Beckstedt, R. E. Beith, A. M. Bitzer, G. E. Black, H. F. Bowes, J. H. Brace, E. I. Brown, C. E. Brown, N. A. Campbell, G. Challen, J. Darroch, W. H. Delaye, H. C. Doorly, G. C. Francis, J. W. Hackner, F. L. Haviland, S. B. Iler, W. C. Kilip, W. S. King, J. B. Lawrence, F. C. Lewis, H. R. Lynar, J. E. Malone, E. D. Monk, J. H. Morice, F. E. H. Mowbray, S. Murray, V. J. O'Donnell, W. D. C. O'Grady, M. Pivnick, C. F. Publow, A. H. Qua, H. A. Ricker, R. C. Robinson, D. Ross, H. F. Shearer, J. J. Spence, G. E. Squire, R. H. Starr, A. W. J. Stewart, J. St. Lawrence, A. D. Sword, C. P. VanNorman, W. J. C. Webster, R. M. Wedlake, R. P. Weir, W. J. White.

Third year—Honors—F. G. Allen, H. D. Bowman, C. B. Connell, R. S. Davis, F. R. Ewart, R. O. Hill, C. H. Hutton, L. G. Ireland, E. W. Kay, D. J. McGugan, F. E. Prochnow, J. F. Procunier, H. Raine, A. C. Spencer, J. L. Stiver, A. R. Zimmer. Pass—W. S. Grady, J. H. Caster, G. P. Coulter, S. D. Evans, C. S. Grasett, K. Hall, R. A. Hare, E. W. Hyman, D. F. Keith, A. D. LePan, J. A. D. McCurdy, A. H. McIntosh, F. W. McNeill, S. A. Marshall, H. V. Maynard, J. B. Minns, J. D. Murray, J. J. O'Sullivan, H. A. Percy, G. E. Quance, C. W. B. Richardson, E. R. Smithrim, G. S. Stewart, O. R. Thomson, A. F. Wilson, M. H. Woods, J. Young.

SUPPEMENTAL EXAMINATIONS.

FIRST YEAR SUBJECTS:

Electricity and Magnetism—H. E. Rothwell, R. H. Douglas, F. K. Harris, K. D. Marlatt, C. E. Webb, H. V. Armstrong, R. D. S. Beckstedt.

Electric Circuits—F. K. Harris, M. E. Nasmith, H. C. Maguire, H. V. Armstrong, H. C. Barber, E. I. Brown, R. H. Hall, H. R. Lynar, J. H. Morice, S. Murray, R. C. Robinson, R. H. Starr, C. P. Van Norman, W. J. C. Webster, W. J. White.

Practical Electricity—G. E. Black.

SECOND YEAR SUBJECTS:

Practical Electricity—J. A. D. McCurdy, J. J. O'Sullivan, D. H. C. Mason.

Electricity—C. C. Bothwell, G. A. Dawson, J. J. O'Sullivan, E. R. Smithrim, A. F. Wilson.

THIRD YEAR SUBJECTS:

Alternating Current—A. E. Uren.

Hydraulics—E. D. O'Brien, W. N McLean.

Electricity—F. Alport.

There is a long list of students to take supplementals.

THE ROBB COMPANY PROSPEROUS.

The Robb Engineering Co. have recently received the following orders: Sydney & Glace Bay Ry. Co., Sydney, C. B., one 18 in. & 26 in. x 12 in. Robb-Armstrong vertical enclosed engine for D.C. to 250 K.W. generator, speed 350; two 250 H.P. 72 in. x 18 ft. return tubular boilers; one 500 H.P. Robb feed water heater steam separator. Brockville Light & Power Co., Brockville, Ont., one 72 in. x 18 ft. return tubular boiler. Alberta Portland Cement Co., Calgary Alta., one 21 in. & 40 in. x 24 in. Robb-Armstrong cross compound Corliss engine direct connected to 500 K.W. generator at 150 r.p.m. Venderbeek & Sons, Jersey City, N.J., for Millerton, N.B., one 14 in. x 14 in. Robb-Armstrong engine on skids; one 72 in. x 16 ft return tubular boiler with castings for Dutch oven; one smoke-stack 50 ft. x 34 in. x 10 guage; one duplex steam pump 7 in. x 4½ in. x 7 in. for fire purposes; one complete rotary mill; one complete lath mill. Town of Truro, N.S., one 150 H.P. Robb-Mumford water tube boiler; one duplex feed pump; one Robb feed water heater. Intercolonial Ry., Moncton, N.B., three 100 H.P. Robb-Mumford boilers. McKenzie, Mann & Co., Toronto, Ont., one 17 in. x 20 in. Robb-Armstrong engine direct connected to 200 K.W. generator; one 10 in. x 10 in. vertical engine, belted; two 67 in. x 18 ft. return tubular boilers; one 250 H.P. Robb feed water heater; one 6 in. x 4 in. x 6 in. Duplex feed pump; one 10 in. x 7 in. x 12 in. Duplex feed pump for fire purposes.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—About how much power can an average man exert?

Answer.—Rankine has prepared considerable data on this subject, and his tables covering work done against the force of gravity show that an ordinary man raising his own weight up a stair or ladder will exert 2,088,000 foot pounds per day of eight hours, which is equivalent to 4,350 foot pounds per minute, or about .132 horse-power. This is apparently the maximum amount covering a long period of time, though the data also includes the statement that in turning a crank or winch for a period of two minutes, 17,280 foot pounds per minute has been exerted, which is a little over one-half horse-power. The data in connection with the horizontal transportation of weights shows higher results than the above, but cannot be considered of value.

Question No. 2.—I would like to know how many ampere turns of No. 24 D.C.C. wire B. & S. gauge it would take to wind the shunt coils on the cut-out side of a Thomson Canadian General Electric Company series arc lamp.

Answer.—Data in connection with such subjects is not usually made public, though possibly you might be able to get the information desired by writing direct to the parties from whom you purchased the lamp. You will probably be given information as to the number of turns, and this will be sufficient for your purpose. The current through the coil, and hence the ampere turns, will vary of course with the arc voltage, which is naturally the voltage across the terminals of the shunt coils.

Question No. 3.—How much current will flow from an alternating current generator on short circuit? We are installing some automatic oil switches, and I want to find out how much current they will have to break in the event of a bad short circuit close to the station.

Answer.—It is generally supposed that an alternating current generator on short circuit will give a maximum of from three to four times its full load current. This apparent limit is due to the strong reaction which the short-circuited coils have upon the fields. Generally speaking, however, a considerably greater current than the above will flow at the instant the short circuit occurs, but this will rapidly diminish until the normal continuous point is reached. One advantage of the time limit circuit breaker is that the moment of opening can be made to occur at any desired interval after the short circuit comes on the line, and hence the breaking contacts are not so severely taxed. The character of your generator or generators will have a great deal to do with the amount of current which will flow at the instant of short circuit. For instance, owing to the character of the metal used in the revolving fields of the Niagara generators, a current of approximately twelve times full load current will flow at the instant of short circuit. If the manufacturer who is supplying the oil switches knows the characteristics of your generator, he will no doubt be able to supply you with an article capable of performing the required work. Usually an oil switch which is of sufficient size to carry the full load current of the generator continuously will be capable of opening the circuit under almost any condition unless there are a considerable number of machines running in parallel.

Question No. 4.—When the efficiency of a storage battery is spoken of, what does this mean, or what should it mean, and how is the efficiency best measured?

Answer.—Sometimes storage batteries are said to have an efficiency of eighty-five per cent., and, while this is true from one standpoint, it does not tell the complete story. If we take a battery of reputable make, we can deliver into it, say one hundred kilowatt-hours, and if this particulary battery has an efficiency of eighty-five per cent., as above mentioned, we will have actually stored in the battery at the end of the charge eighty-five k.w.h., but the fact must be be overlooked that in order to utilize this stored energy it must be taken out of the battery again, during which operation there is another loss of fifteen per cent., so that of the original one hundred k.w.h. which we put into the battery, we can only take out and use approximately seventy-two. Therefore the efficiency of the battery should be spoken of as seventy-two per cent. It is usual to install two integrating wattmeters, for the purpose of not only measuring the efficiency, but also for showing to what extent the battery is being worked. These wattmeters have the shunts permanently connected across the bus bars, the shunt of one meter being reversed, and the fields are in series with one bus bar. Hence one meter will go forward and the other backward on charge, while on discharge the condition is reversed. On the dial of each meter, however, there is a latch arrangement, so that the meters records in one direction only, therefore on charge one meter will record, and on discharge the other dial is moved. The latch arrangement prevents the dials from running backward. A combination reading of the two meters will show the total energy put into the battery and the total energy taken out, which, of course, will give the efficiency.

The small son of an electrician was spending his first summer in the country, at the home of his grandparents. One morning, while playing in the garden, he found a small yellow "bug," and as his grandfather had promised to take him fishing that afternoon, he decided to catch it to use as bait. A few seconds later a most astonishing commotion, considering the size of the cause thereof, arose in the garden, and grandmother hurried out from the house.

"Why, what is the matter, child?" she asked, taking the little fellow in her arms.

He raised a tear-stained face.

"I don't know," was the reply. "I was catching a pretty yellow bug, an' must have touch a live wire."

ELECTRIC WORK IN TORONTO.

The electrical department of the Canadian Fire Underwriters' Association, in charge of Mr. H. F. Strickland, chief inspector, last month issued Bulletin No. 10, for the purpose of notifying the electrical trade and other parties interested of certain points in connection with the observance of rules which are more or less disregarded. In this connection it may be stated that the object in standardizing all details is to place all contractors on an even footing, so that those who figure on standard material will not be obliged to meet the competition of contractors who always seek to substitute something which is not strictly in accordance with the requirements.

Bulletin No. 10 covers the following points:

Grounding Clamps.

Owing to the fact that no standard grounding clamp has been adopted, and as there is always a class of wiremen seeking the cheapest method of complying with a requirement, it has been found necessary to adopt a standard for all parties alike. We therefore beg to notify electrical contractors that grounding must be done in all cases through the medium of approved grounding clamps, and that other than the standard grounding clamps will positively not be accepted, and the inspectors have been notified not to issue certificates of approval on any installation that is not grounded through the medium of grounding clamps and No. 8 copper wire. Where lorieated pipe is used it is necessary to clean the enamel off the pipe before attaching the clamp, and for service pipe it is recommended that only galvanized conduit be used.

Extract from National Code, 1906.

"In connecting a ground wire to a piping system, the wire should be sweated into a lug attached to an approved clamp, and the clamp firmly bolted to the water pipe after all rust and scale have been removed."

Meter Boards.

Owing to the unsatisfactory manner in which some contractors leave the service connections, we beg to notify parties interested that final certificates will not be issued until the wiring, switches and meter loops have been left properly finished, together with a proper meter board covered with heavy asbestos card. It is recommended that all meter boards be provided with a hardwood enclosure lined in a similar manner.

Service Switches.

Under no conditions are service switches to be less than 25 ampere capacity, and must be approved switches with approved washers and substantially constructed. This is a provision of the new code, which will be printed in June next.

Outlet Boxes.

On and after May 1st next, no wiring will be accepted where approved outlet boxes are not provided. This is a provision which is recommended in the new Code, which will be printed in June, and will be enforced by the Association in the City of Toronto. Samples of these boxes are to be seen at the electrical department of the underwriters. In cases where it is impracticable to install outlet boxes, they may be omitted by permission in writing from the department having jurisdiction. The boxes to be used on these installations must conform to the requirements of the association, and none others will be accepted. The requirements are, that at the point where the wires enter the box they must be provided with an insulating bushing, secured in such a manner that it cannot be removed, and that from this point to the last insulator the wires must be enclosed in the same manner as at the present time, and the box must be so constructed that it will be effectually insulated from the gas pipe with an insulating ring of wood fibre or porcelain, not less than 3-16 inch in thickness, and must be constructed so that all openings, other than those in use, will be effectually closed. This box may be also constructed in such a manner that circular loom will enter the same so that it cannot be readily pulled out or pushed back, in which case the porcelain bushing will not be required. Contractors and others using outlet boxes are advised to submit the style which they propose to use and have them approved. Combination boxes must be insulated from the gas pipe by approved bushings that cannot be removed when installed.

Lining to Cut-Out Cabinets.

All cut-out cabinets should be lined with fireproof insulating material, irrespective of the class of cut-out it is to contain; asbestos must be heavy card, and not thin paper, which is sometimes employed for this purpose.

Extract from National Code, 1905.

"Material.—Cabinets must be substantially constructed of non-combustible, non-absorptive material, or of wood. When wood is used the inside of the cabinet must be completely lined with a non-combustible insulating material. Slate or marble, at least one-quarter inch in thickness, is strongly recommended for such lining, but, except with metal conduit systems, asbestos board at least one-eighth inch in thickness may be used in dry places if firmly secured by shellac and tacks.

"With metal conduit systems, the lining of either the box or the gutter may be of one-sixteenth inch galvanized, painted or enameled iron, or preferably one-quarter inch slate or marble."

STATIONARY ENGINEERS' CERTIFICATES.

The Legislature of Ontario at its recent session passed an Act respecting stationary engineers, in which engineers and employers are alike interested. Briefly stated, its provisions are that, after the first day of July, 1908, no engineer will be allowed to operate or have charge of a stationary steam plant of 50 horse-power or upwards who does not hold a Government certificate. There are three classes of engineers to whom certificates will be granted without the applicant having to undergo an examination, first, those who, on the 20th of April, 1907 (the date on which the Act was passed), held certificates from an association of stationary engineers in Ontario, or a marine or locomotive engineer's certificate; second, engineers who, on the above date, were in charge of a plant of 25 horse-power or over in Ontario; third, engineers who had at any time previous to the passing of this Act not less than two years' experience in the operation of such a plant in the province. Those who cannot qualify as above will have to pass the examinations which will hereafter be prescribed by the Board of Examiners.

Those interested may obtain a copy of the Act and application forms for certificates by addressing The Secretary, Department of Agriculture, Toronto.

AN AMMONIA PLANT.

Mr. Geo. L. Oill, manager of the Light, Heat & Power Department of the City of St. Thomas, writes The Electrical News as follows: "The City Council is considering the advisability of installing an ammonia concentrator, but as yet have not decided definitely. They are gathering data. The liquor is at present running to waste in the city sewer, and, we believe, a saving of from one thousand to twelve hundred dollars per year can be made from the present amount of coal carbonized."

Mr. Hugh B. Morris, electrical engineer and contractor, Montreal, has secured the electrical contracts for McGill University and the H. B. Martin Company's abattoir.

The City Council of Winnipeg last month accepted the tender of the Canadian Westinghouse Company, of Hamilton, for 200 arc lamps, 200 cut-outs, two regulating transformers, switchboard and lighting arresters for the street lighting system. The price is $8,095.

Simultaneous Telephone and Telegraph

By Frank M. Slough and M. E. Taylor.

For a long time the first expense for apparatus used for simultaneous telephone and telegraph service retarded commercial recognition of its industrial value, due to the fact that expensive and complicated equipment had been supposed necessary for its operation, besides the results were very uncertain. Long and careful study, with practical results, have, however, within the last few years placed simultaneous telephone and telegraph in such harmony that all of the larger long distance toll companies are adopting it on account of the large revenue, which can be secured with a very small extra expense by leasing the wires for telegraph service to parties desiring the same, such as brokers, newspapers, etc.

In taking up this subject the writers have decided to discuss only the practical methods such as have been used under service conditions with good results; also to give briefly the different methods by which these results may be obtained, and as far as possible explain the advantages and disadvtanges of the several methods which may be divided into two systems—simplex and composite.

Simplex systems are based on the Wheatstone's bridge principle, and are capable of rendering only one telegraph circuit from one metallic line, while the composite systems are based on the different effects which the alternating current has on condensers and impedance coils, and provides for two complete telegraph circuits over the same metallic line.

We will first take up the simplex system, as it is the simplest and the first that was used to any great extent. It will be necessary to subdivide this method into the impedance and repeating coil systems, either of which have their own advantages.

Figure 1 shows a toll line which represents the natural condition of any toll circuit as it exists between two exchanges described as A and B.

The first step in cutting in a telegraph circuit by the impedance simplex method without interfering with the telephonic use of this line is clearly shown in Figure 2, in which it will be noted that an impedance coil is cut in at each end of the line, C1 and C2. These coils do not cut down the transmission of speech to any noticeable extent for the reason that they offer a high impedance to the high frequency voice currents, and are so wound that a middle tap can be brought out of the winding and which is connected to the telegraph instruments through battery to ground.

These coils may be made up in the same manner as a repeating coil, or for cheaper installations, the two coils of an ordinary ringer will suffice, care being taken to have them of sufficient resistance as not to cut down the telephonic transmission to a very great extent. However, it is never good practice to have them wound too high, because it will then be necessary to use an extremely high voltage to operate the telegraph relay at the distant point. Coils having a closed magnetic circuit are best for this purpose, as when wound to only a moderate resitance they still offer a high impedance to voice currents as before stated, permitting a low voltage to be used for telegraphing.

It will also be noticed in Fig. 2 that condensers K1 and K2 are cut in on each side of the circuit between the line jacks and impedance coils, and serves the purpose of keeping the telegraph current from passing over the local subscribers' line which is liable to grounds and crosses, which would seriously interfere with telegraph service.

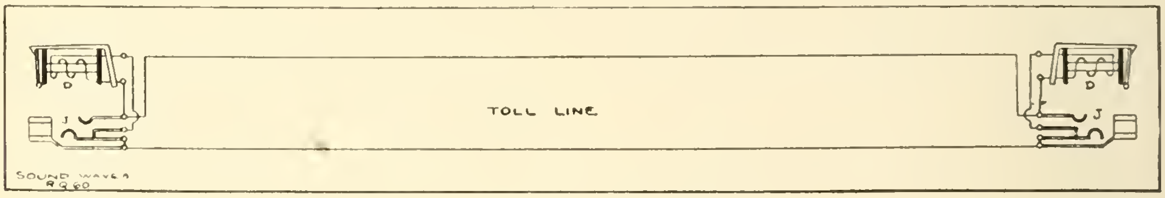


Figure 1—Toll Line Circuit.

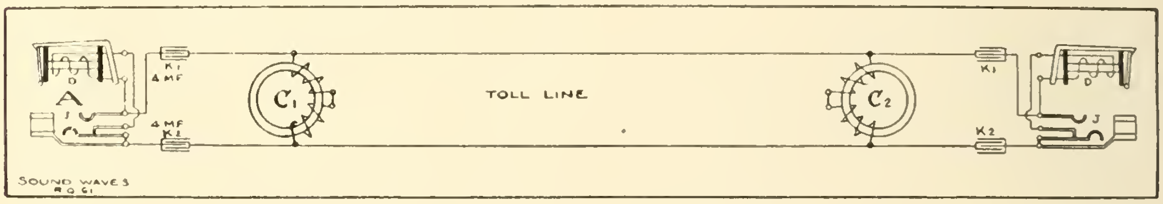


Figure 2—Arranging Toll Line for Simplex Telegraph Service.

As these condensers are intended to allow the voice and ringing currents to pass through without diminution, it is important that they be of a moderately high capacity, say, four m. f. These condensers can most easily be procured of a capacity of two m. f., and if these are used it will be necessary to use two condensers instead of the single four m. f., and the same results will be obtained.

The advantage claimed for the impedance coil system is the small cutting down of telephone transmission and the good ringing results, so long as the line and all connections connected thereto are perfectly clear from ground. This latter feature is a failure, in a great many instances, from the fact that few exchanges can use their power and hand generators for ringing without receiving ground connections in some manner; which has a tendency to operate the telegraph relay and greatly affecting that service. The unbalancing of the line by any permanent or swinging ground connection causes the telegraph impulses to be audible in the telephone receiver. Any connection from the line to ground will cause trouble in

any system, and, so far as practicable, should be avoided.

It is therefore obvious that this method could not be used where the toll line is likely to be connected to lines which operate on the common or ground return system, or are unbalanced to a very great extent.

It is also necessary to have an absolutely ungrounded generator to ring down the drop at the distant end of the line, as a grounded generator would interfere with the telegraph instruments when connected to the line. Yet, when the line could be kept entirely clear from ground connections, the impedance service is much the preferable. As stated, both the telephone transmission is excellent and the ringing is very satisfactory.

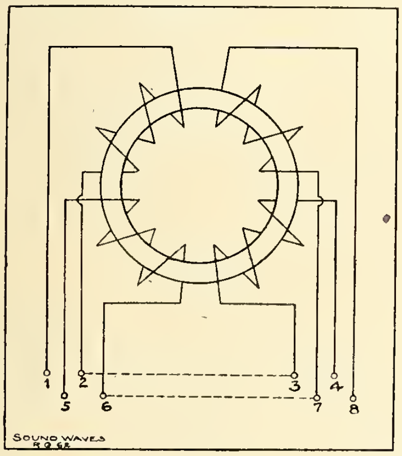


FIGURE 3—SIMPLEX REPEATING COIL CONNECTIONS.

These troubles are for the most part absent when repeating coils are used, as there is no direct connection between the switchboard jacks and toll lines, the same being perfectly insulated from each other, due to the fact that they are connected to separate windings on the coil.

The principal trouble with repeating coils is their inefficiency for both talking and ringing currents, due to the well-known fact that a coil built for ringing currents, which are of a comparatively low frequency, about twenty cycles per second being the average, is inefficient for the high frequency voice currents, which average 750 cycles per second, and vice versa; a coil built for both, as is necessary in this work, is necessarily a compromise between the two designs, and consequently somewhat inefficient for both purposes.

Where the repeating coils are used in place of the coils already described it is obvious that condensers K1 and K2 can be omitted, as the line and switchboard windings of the repeating coil are insulated, one from the other.

Repeating coils for this purpose are generally of the closed magnetic circuit type and are designed so as to allow ringing currents and voice currents to pass through with very little loss.

Many coils for this purpose have been designed and, in general, nearly all have the same characteristics, viz.: A closed magnetic circuit, with four separate windings, the whole to be enclosed in an iron tube which effectually prevents cross talk from one coil to others adjacent to it, and also protects the coil from injury, etc.

It is well to install coils, the four windings of which are equal in resistance and number of turns, and also are so placed on the core as to have the same electrical effect. This is done commercially in several ways, by different manufacturers, each of which has its own advantages.

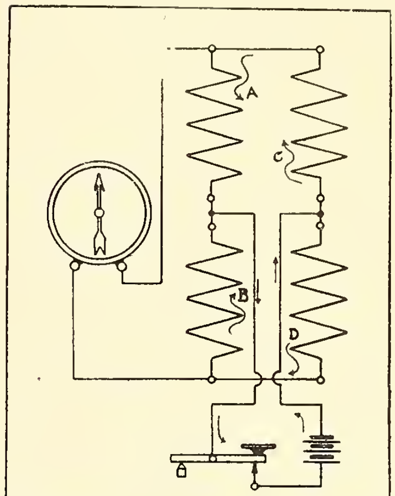


FIGURE 5—WHEATSTONE BRIDGE PRINCIPLE.

This method of operating simultaneous telephone and telegraph has become very popular with both large and small toll companies, for the reason that the ground ringing current does not affect the telegraph conditions, neither are the telegraphic impulses so noticeable in the telephone circuit. Figure 3 shows the connecting contacts and windings of a repeating coil adapted to the repeating coil simplex system. Coils 1, 2 and 3, 4 are connected as one coil at terminals 2 and 3, as illustrated, and as toll line side of coil. Coils 5, 6 and 7, 8, connected at 6 and 7 represents the switchboard side of coil. Telegraph connections at 2 on line side of coil is commonly called the leg of the coil and will be expressed, hereafter, by that term.

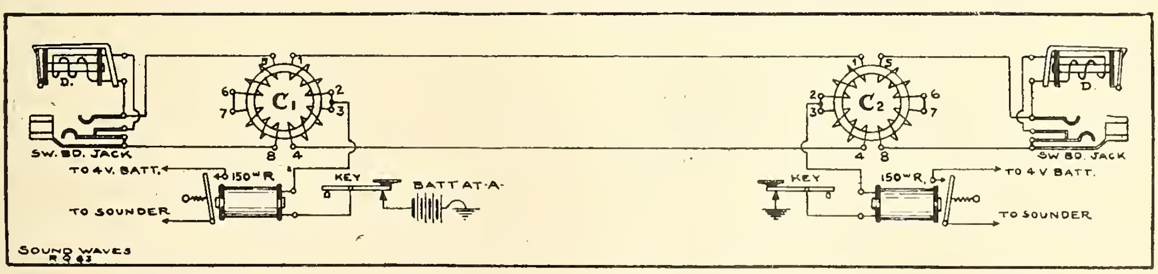


FIGURE 4—TELEPHONE LINES WITH SUPERPOSED TELEGRAPH CIRCUIT.

It is readily seen that, by this construction, the centre point of the coil can easily be secured for telegraph connection. It has been found that coils having four insulated wires twisted together and wound on the same core give excellent results, as with this arrange-

ment the four coils can be nearly balanced—the vital feature in simultaneous telephone and telegraph operating.

The resistance to which these coils should be wound depends much on the nature of the lines in which they are to be connected. If you have a line which is liable to be unbalanced to a very great extent, it is best to use a coil, the windings of which are rather high in resistance, and the reverse is also true, that is, a very low wound coil can be used to advantage on a very well balanced line.

For a coil that will meet the conditions most commonly met with in practice the writers would suggest a coil not lower than 100 ohms. and not higher than 200 ohms. per winding, the lower figures being used wherever possible as the telephone transmission is better.

In Figure 3 and, in fact, all future figures relating to simplex circuits, the repeating coil system only is shown, it being understood that with a few exceptions (hereafter noted) the electrical action is the same.

The most common arrangement of the telegraph circuit is shown in Figure 4, complete, so far as the operation of the telegraph instruments are concerned, and it will be seen that when the telegraph operator at A depresses his key, he sends an impulse of direct current over each wire of the pair simultaneously, the current dividing at T and traversing each half of the coil winding C1 in opposite directions, equal quantities of current traveling over each line wire L1 and L2, and thence to return to ground at B in the same manner as at A; the path taken being shown by single headed arrows.

The telephone circuit, shown by double headed arrows, is metallic, and is not affected by this telegraph current, for the same reason that in a balanced Wheatstone's bridge the galvanometer needle is not affected when the battery key is depressed or released. See Figure 5.

The telegraph legs correspond to the battery supply, telephone receivers correspond to the galvanometer and the line wires, and the coil windings correspond to the four branches a, b, c and d of the Wheatstone's bridge. A perfectly balanced coil on a good line will permit a highly efficient telephone received to respond to a small extent to the telegraphic impulses, if some arrangement is not provided for taking up the discharge of the circuit and smoothing the telegraph wave. Any telephone man knows that there are very few lines which are considered good that are perfectly balanced; and, therefore, the system must be able to stand a slight unbalance of line conditions without any serious results. The telegraphic impulse, as it is impressed on the telephone circuit, changes rapidly in strength, rising almost instantly to a maximum, remaining there a period of time corresponding to the time the key is depressed, and then falling to zero when the key is released; also the coils in the circuit discharge at this time, which causes the telegraphic impulse to terminate with a high peak.

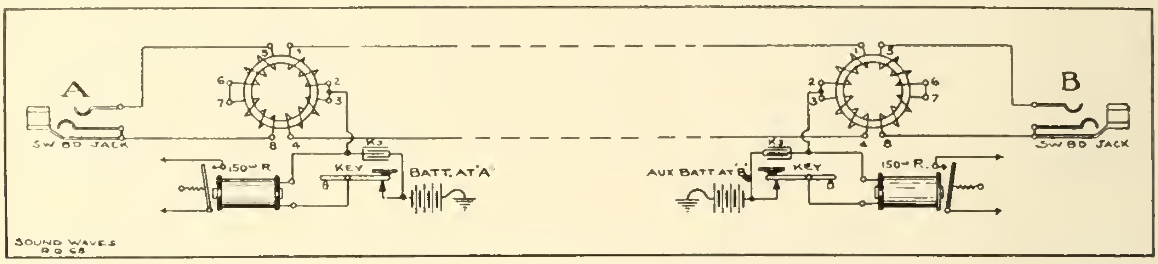


Figure 6—Combined Telegraph and Telephone Circuit.

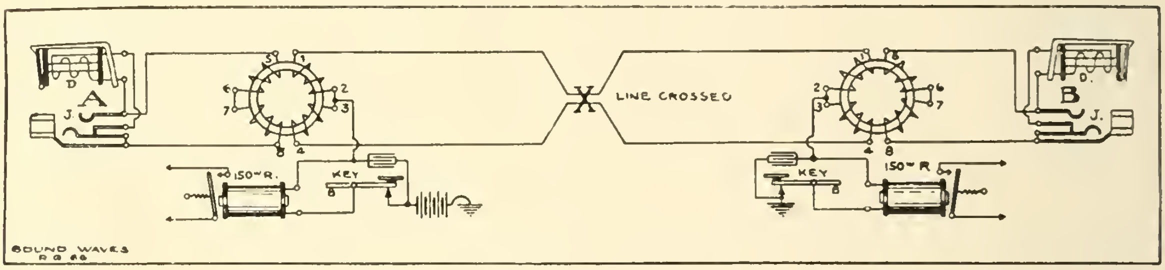


Figure 7—Showing Effect of Cross of Line Wire.

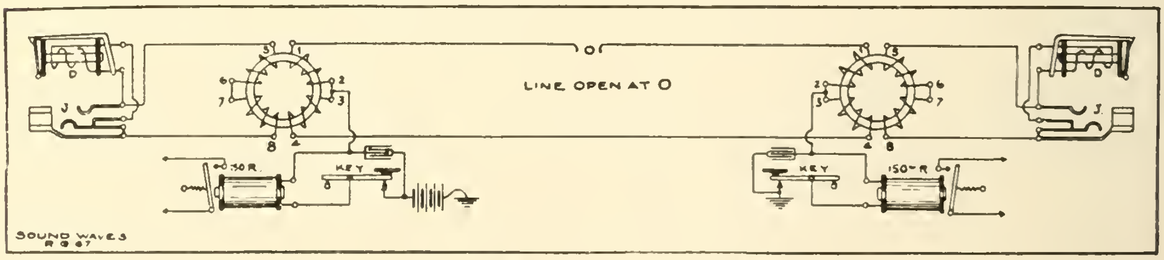


Figure 8—Showing Effect of Open Wire.

These sudden changes would have a great deal of influence on the slightly unbalanced telephone circuit, and in order to make this influence as small as possible, capacity or inductance or both are so placed in the circuit that they have a retarding effect and the charges are accomplished at a slower rate.

A condenser of from four to ten m. f., placed in the circuit, as K3 as in Figure 6, has a smoothing effect on the telegraph wave and causes it to have a great deal less effect on the telegraph wave, and less effect on the telephone circuit than before.

A condenser connected in this manner has a reaction which opposes the counter e. m. f. due to the inductance of the line and instruments which rises rapidly when the circuit is broken by the telegraph key, as before stated, and tends to make it cause less interference in the telephone sets, than it otherwise would.

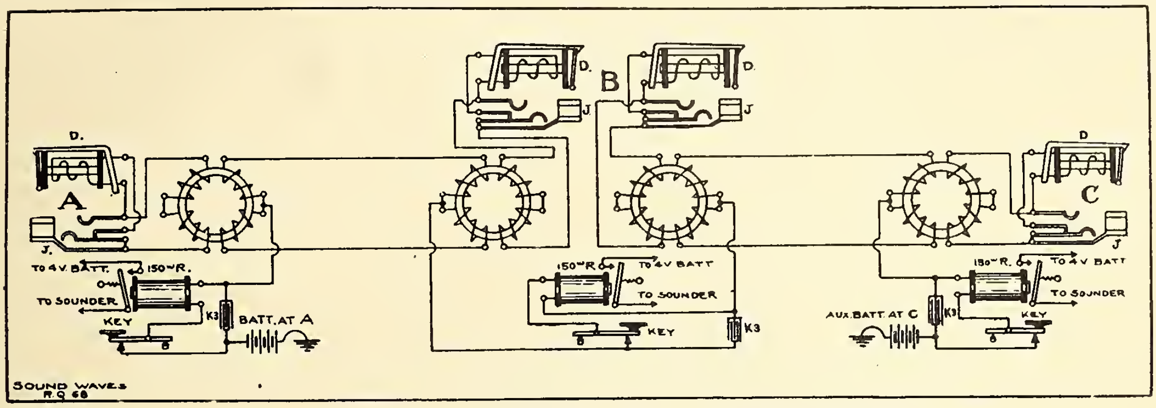


Figure 9—Intermediate Telephone and Telegraph Stations.

If the condenser is placed merely around the telegraph key it seems to work equally well and at the same time does not slow down the operation of the local telegraph relay, as is the case when placed in multiple with the entire instrument. This former arrangement is found to give results which are quite

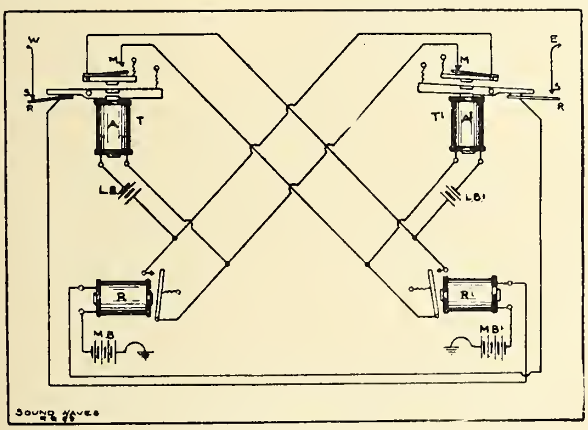


Figure 10—Ghegan Telegraph Repeater Circuit.

satisfactory, except that there is a tendency for sparking to ensue at the key contacts, especially where a high voltage is used.

It will be noticed, by following the telegraph circuit in the different illustrations, that the current is equally divided on either side of the line; or, in other words, the metallic line represents the same as one conductor. Thus the line may be crossed or one side open and the telegraph will still continue to operate. These conditions are clearly illustrated in Figures 7 and 8. The former shows the line crossed at X, while the latter shows one side of the line open at O. These conditions in no way affect the telegraph operation. It is to be clearly seen, however, that under either of the above conditions the telephone circuit is out of commission.

Figure 9 shows theoretically how a telegraph circuit is connected through an intermediate station, B representing the intermediate connection.

The toll line from A to B and the one from B to C are separate lines and used as such for toll service, while they represent but one continuous line for telegraph purpose.

Figure 9 shows a telegraph station to be connected at the intermediate station B, which is supplied by battery from station A to C. In this illustration also is shown another battery connected from ground to the telegraph line through the Morse instruments, at C, this battery acting as a booster to the battery at A, and compensates for loss of current along the line due to leakage, which amounts to quite a loss of efficiency, especially if the line is a very long one.

Often at an intermediate station, such as B, a special repeater is placed in the circuit, which acts as a two-way relay; that is, when actuated by weak impulses of battery from either direction A or C, that it sends the same kind of impulses from an auxiliary battery in the opposite direction; this action being clearly shown in the circuits of this so-called Ghegan repeater in Figure 10, which is connected in place of the ordinary telegraph relay at B, as in Figure 9.

Often it is desired to terminate two telegraph circuits at the intermediate station B and leave the telephone line connected through. This can best be done in a manner similar to that shown in Figure 9, except

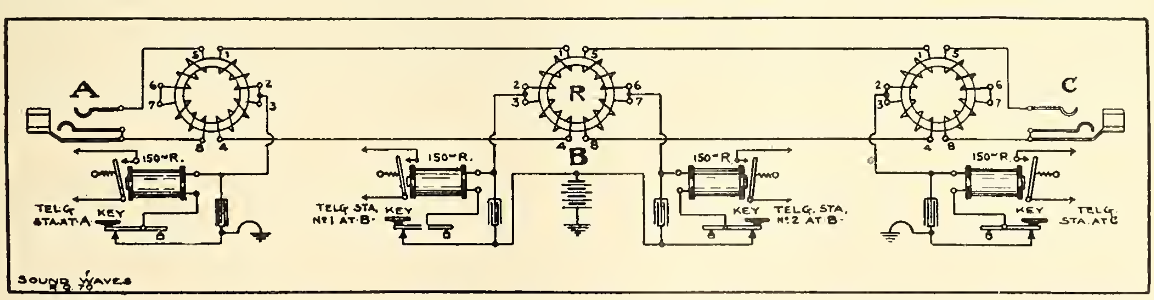


Figure 11—Through Telephone Service and Intermeeiate Telegraph Stations.

that each telegraph leg of the coil belongs to a different telegraph circuit and, as instead of two telephone circuits we have only one, it will only be necessary to use one repeating coil, designated by R in Figure 11. Test panels and circuits to be discussed in the next article.—Sound Waves.

MONTREAL

Branch Office of The Canadian Electrical News,
Room B34 Board of Trade Building.

May 10th, 1907.

At Tuesday afternoon's session of the Fire Commissioners, says a Montreal exchange, the blaze in the premises of N. Quintal & Son, 274 St. Paul street, which occurred on April 20th, was investigated. The manager, Mr. W. C. Wheissen, was the last to leave the store at 6.40 p.m., when everything seemed to be all right. The fire is thought to have originated from wires connected with a dry battery in the cellar, used for telephonic purposes throughout the building. There was nothing inflammable in the cellar, and the furnace was out. And this was a system of interior warehouse telephones, too!!

The insurance people made a slight attempt to fasten the responsibility for the fire at Mr J. N. Greenshields' residence on "high tension." There was found, however, to be no foundation for this, as the wiring outdoors was in good order, also the transformer, and the indoor wiring had been done in iron conduit. It would appear necessary ere long that the underwriters' testing laboratories should specify in their list of approved fittings the makes of transformers which they consider satisfactory if insurance companies are going to look in many cases for trouble at the transformer. It does not seem fair to an electric light company who are using good material to be blamed for a matter over which they cannot possibly have any control. Of course, this refers to companies who take an interest in their transformers and pay the money necessary to buy good goods, and also have a testing department to see that they are getting what they pay for.

The valedictorian of the Science course, McGill University, made a stirring indictment in his speech this year against professors taking on outside work. It certainly seems a strange anomaly for a high-paid professor to cut business out of the hands of the very technical engineers who have been educated as it were under his own hands.

It seems strange that a building so fully equipped with the higher grades of electrical machinery, as was the late McGill Engineering Building, should disdain the use of such a simple protective agent as the electrically operated watchman's time recorder. As a matter of fact, there was even no night watchman. Possibly, owing to the nature of the building, the fire will be put down as having been caused by electric wires, but the building had a private plant, which was shut down hours before the fire occurred.

The Nernst lamp department of the Canadian Westinghouse Company are pushing their Multi-Glower 220 volt A.C. lamps, and have already secured orders for some of the most prominent buildings for their equipment. The Nernst lamp department here are now willing to quote a figure for the maintenance of their lamps which enables a possible customer to calculate pretty closely the expense. As to the quality of the light, there is nothing left to be desired on this head.

The Automobile Show was held in the Arena at Montreal, similar to last year. The show was probably a success from the point of view of the automobilists themselves, but "electries" were sadly conspicuous (it is to be regretted) by their absence. There were some good working exhibits of spark coils, dry batteries, and the like, by various dealers who make a specialty of such lines.

The Street Railway Company were treated to a magnificent fall of ten inches of wet, packing snow on the 8th of April, and had quite a little more of it two days afterwards, when a regular blizzard raged all night. The contract to keep the tracks open and working was pretty strenuous, but the company handled it very credibly.

It is doubtful if any industry can show such rapid changes as the electrical. Only three years ago staple articles, such as rubber covered wire, sockets, cut-outs flexible, cord, etc., were purchased in bulk in the United States; to-day they are all made locally, and importations have practically ceased. Not only so, but in one of these items mentioned we have a factory here equipped which is unsurpassed by any controlled by our American friends.

The electrical inspection which was hinted at by city representatives has, like a good many other similar promises from the city, apparently died a natural death. Perhaps this may not be an unmixed blessing, as it is doubtful whether or no the underwriters who have the funds at stake would accept the inspector or inspectors who might be selected by the city. The city's reason for dropping it seems to be that were a building to burn after being inspected they would be liable, although goodness knows we have seen at least one building falling to pieces and no attempt made to fix the liability on the Building Inspector. As a matter of fact, however, the underwriters should do it, and not only is it a shame that they do not recognize their duty in this matter, but apparently they have never given a thought to the fact that the inspection department would be self-supporting from fees and they could easily make inspection compulsory.

The vigorous crusade that the inspection department of the Montreal Light & Power Company started in with about a year ago has certainly produced grand results in the centre and western portions of the city at any rate, although the requests made by their inspectors were for a time a source of constant irritation to the various contractors. It is well-known that certain rules are very ambiguous and there is more than one way of construing them. Things are working more smoothly now, but the east and northeast portions of the city are far from being in good shape. And, as for the moving picture apparatus, of which no less than five are constantly being exhibited in various parts of the city, there is not one of them equipped as per underwriters' regulations, and every one of them is an electrical fire hazard.

The inspection department of the Montreal Light, Heat & Power Company are having not a little trouble in deciding on the merits of certain British fittings, which are not mentioned at all in the National Code Rules, but which undoubtedly have merit. These points are now under investigation, and some of them will be accepted. One item (viz., the tumbler switch) is now accepted and is thought to be superior to the snap switch of American manufacture, although the latter is mentioned and passed in the National Code Rules, and the former would apparently not be acceptable under the printed description of what constitutes a safe switch. As soon, however, as the present stock on hand of English tumbler switches are disposed of, the inspection department of the Montreal Light, Heat & Power Company will insist on the covers being lined. There is really not a great deal of additional protection in this, as the cover is not held in place by the handle of the switch, but as lined ones can now be had the company desire to enforce all the protection possible.

The "Pay-As-You-Enter" cars are proving a brilliant success in so far as handsome rolling stock is concerned, but at the rush hour are even more successful in losing fares, as no less than seven free fares were noticed on one Windsor and St. Lawrence car the other evening at 6 p.m. The old style of cars even in their palmiest days did not produce such a percentage of loss in fares, and this was apparently the great point made for the "Pay-As-You-Enter" type. The matter of their nuisance to ladies, children and elderly persons still remains.

The Bell Telephone Company are just putting the finishing touches on their handsome up-town exchange on Mountain street, and have in the last two or three days started to break ground for a considerable extension to their exchange in Westmount. When all these exchanges are completed they will probably all be on the central energy system.

Apparently business with the manufacturers is good, or deliveries would not be so slow all round.

THE COMMERCIAL TRAVELLER VS. THE AD.

There is no versus to it—one is the support of the other. It's all nonsense to believe that a territory is covered because a traveller goes over it once every year, or every six or three months. He may get the business that is going at the time he is on the ground, but, how about the intervening time? How about the time before he has appeared at all? How about the little places he has missed—did not think them worth while, or perhaps did not find the buyer at home when he called? That is where the advertisement comes in. The ad. goes before the traveller and proves an introduction for him. It's there when he is there, and it comes along after he is gone to remind the customer of him—and the house he represents. It's working all the time.

THE STUART-HOWLAND COMPANY.

We illustrate herewith the principal offices and warerooms of the Stuart-Howland Company, of Boston. This company started business only seven years ago, but as it has been especially aggressive and always painstaking in catering to the wishes of its customers, its growth has been unparalleled. The volume of its business now is considerably more than double that of two years ago, and it ranks among the two or three largest electric supply houses in America.

The head of this concern, Mr. Stuart, is a Canadian by birth and is deeply interested in the growth of Canadian industries, and while he looks with pleasure and pride on the push and energy of Canadians which has brought about the great prosperity which this country enjoys, he claims that there are many lines of electrical supplies which can be purchased in the United States to advantage.

Assuming this is true, the Stuart-Howland Company are in an unique position to supply Canadian buyers, for the following reasons:—

First, it is situated so close to the Canadian border that deliveries are more prompt and transportation less expensive than from any other large supply house.

Second, it carries always in its warerooms an immense stock of everything electrical, perhaps the most complete line in street railway, telephone and lighting supplies in the United States, and, being located in the heart of the great electrical manufacturing district, can quickly replenish any shortage.

Third, its management has kept in close touch with Canadian buyers and their needs and is especially equipped to cater to Canadian requirements.

It has an efficient corps of clerks and managers for the various departments, and all inquiries and orders will have alike prompt and careful attention.

It has now in the hands of the printers and will issue within a few weeks a new catalogue which, it is believed, will eclipse any supply catalogue heretofore issued, and which it will be pleased to send gratis to anyone regularly engaged in the electrical business and entitled to wholesale prices.

Offices and Warerooms of the Stuart-Howland Company, Boston.

Mr. H. C. Miner has retired from the presidency of the Consolidated Rubber Company and has been succeeded by Mr. D. Lorne McGibbon, who becomes managing director as well as president.

THE NEED FOR CHEAPER METHODS OF DISTRIBUTION

For many years past engineers who have studied the various outside questions bearing upon the electrical industry, and who have intelligently foreseen the progress in gas lighting which would be caused by the development of the incandescent mantle, have been calling for the introduction of cheaper methods of distribution, including under this heading interior wiring, as well as the methods adopted of conducting the current to the consumers' terminals. Hitherto they have been crying in the wilderness, vainly attempting to overcome the force of preconceived ideas, for there were very few who imagined that the time was fast approaching when the mantle would arrive at the high standard of excellence that it has reached to-day, when it was actually threatening the supremacy of the arc, and only beaten off by the timely advent of the flame pattern. But there are many who can see that, unless the cost of distribution is considerably reduced, electricity will be sadly handicapped by the items of first cost and increased capital charges when it seeks to open up that new field which all agree it will shortly have to find.

Complications have been added owing to various improvements in incandescent lamps, and with the metallic filament lamp looming in the near future, it would appear that the remarkable efficiency of electric lighting will eventually kill competition from the gas mantle. At the same time, it is evident that, owing to this very efficiency, station engineers will have to considerably widen their scope of action, and by judicious extensions to their mains search for customers in neighborhoods which hitherto have remained untapped; customers who will in the majority of cases be of a pooper class than have yet been connected to the supply. With this class of customers there are many points to be considered. Firstly, they are, as we have said, of a financially lower standing. Secondly, their dwellings will be smaller, and they will require fewer points wired than the average of houses supplied at present. The cost of connection in proportion to the lamps connected, and consequent units consumed, will be much higher, and great care will have to be taken lest the increased capital expenditure more than swallows up the revenue in interest and sinking fund.

A necessary corollary from the first point is that the cost of wiring will present an obstacle which will be difficult, if not practically impossible, to surmount. The house is usually occupied on a much shorter tenancy than that of the better class client, and, owing to the exigencies of the trade or business of the occupier, he may, in many cases, at only a week's notice, have to move to other premises. At any rate, the danger of this is constantly before him, and he will, in consequence, be extremely averse to wiring his own house. In the case of new property, the supply company or corporation may make arrangements with the landlord by which he wires the whole of the premises, they bearing a portion of the expense. In cases where this is not adopted, the supply authorities may bear the whole cost themselves. This might, however, be treading on dangerous ground. The increased expenditure would be an item not to be neglected, and few corporations have wiring powers. In any case the idea would meet with opposition from contractors, and others who, rightly or wrongly, object to electricity works either taking the bread out of their mouths or risking money in more or less unremunerative schemes.

But at any rate the supply will have to reach this district in some way, and it will be necessary for engineers to very carefully consider the methods adopted for this, bearing in mind the fact that the revenue per lamp connected will most probably be considerably less than they have hitherto received. It is an open question whether, in itself the whole principle of distribution adopted has not been commercially wrong; whether the methods used have not been such as to raise the capital charges beyond all reason—resulting in high prices and small profits. Are underground mains necessary, and are they even advisable? They are not particularly free from breakdown, nor from leakage. They are extremely expensive in first cost, and are subject to fairly rapid depreciation. Each system adopted appears to have some trouble peculiar to itself. Take, for instance, the very reasonable bare strip system introduced by Crompton. This is subject to flooding and chemical action. In cases where this is used it is no uncommon thing to find huge masses of crystalline deposit forming over insulator and strip. Other mains are more or less subject to mechanical injury, and all are costly compared with a good overhead system.

With any arrangement of underground mains it is a tedious, difficult and expensive matter to connect a customer. The ground has to be opened up, and a length of expensive armoured cable run into a convenient position. When the consumer's tenancy expires, this cable has to remain, on the chance of someone else taking the house and using the light. It is obvious that this is uncertain. He may not wish to use electricity, and should he do so, he may not be a good customer. Taking into consideration the trenches that have to be dug, the labor of getting through the foundation wall, the making good, and the expensive nature of the material necessary, underground mains would seem very unsuitable for commercial development.

It appears evident that cheaper methods of distribution will have to be seriously considered from a different standpoint from which they have hitherto been viewed. Obviously, the most promising of these is the use of overhead mains. There appear to be very few valid reasons as to why these should not be more largely used. They may not be pretty, but neither are trolley wires, yet we have grown accustomed to them, and few at present regard them as an eyesore. Most station men look askance at the very idea of overhead wires, and the Board of Trade has, it is true, somewhat of an objection to their use. But it is probable that station men in the near future will be delighted to run them in order to gain, without undue expense, the customers that, owing to the coming of the metallic filament lamp, and the consequent decrease in individual consumption, it will be necessary to connect to his mains, in order to attempt to counterbalance this by increased use.

With overhead mains the question of atmospheric

action and consequent corrosion looms before us. In some towns bare copper or copper alloy would rapidly depreciate, especially when run near chemical works, or in seaside localities. I gather that in the neighborhood of some towns, as Middlesbrough, owing to the presence of sulphur, etc., in the air, the telephone wires require renewing every year or so. This action, in cases where heavy currents were passing, would by pitting or local corrosion probably cause a drop in volts, owing to the reduction in sectional area, if bare copper were used. If the copper was coated with insulating material, it is difficult to see how the prime cost could be kept down sufficiently, or whether even the insulation would withstand these influences coupled with ordinary atmospheric conditions. It would seem that some system of periodical painting, either with tar or some flexible varnish, could be used which would overcome this difficulty. The question of supports would have to be weighed, and the result of sudden short-circuiting, going to earth, or breaking under weight of snow, would have to be taken into account. Also, it must not be forgotten that where these are at present used they have not been found wholly satisfactory, and are being placed, especially in America, with some underground system. But it would appear that the question of first cost will force engineers to give more attention to this matter in regard to the opening up of new and poorer class districts.

As an illustration of the saving that may be effected by the use of a good overhead system, the chief electrical engineer of Huddersfield, Mr. Mountain, estimates the cost of connection per customer on the average for a low pressure underground system is about £7. By adopting overhead mains, however, this average cost is reduced to about £4, in each case meters and cut-outs being included. Speaking generally on the subject of overhead conductors, Mr. Mountain said that the cost of overhead mains in a system where conductors of small sectional area were used might be taken to be about half the cost of an underground system, the heavier the main the less being the advantage of placing it overhead.

Probably at first many experiments will be made with unarmoured cables laid directly in the ground, protected possibly with tarred boards, or laid in troughs filled with gravel. Such a system as this would certainly cause ultimate trouble, owing to the fact that the filled troughs would act as drains for surface water. Chemical action would be very serious. As, therefore, existing underground systems would be too expensive, and experiments in unarmoured cables be possibly disastrous, the overhead method will probably have to be adopted.

In places where electric traction is used it will be possible to couple blocks of houses through some form of voltage regulator direct to the trolley wires. Already is this done in Douglas, and, I believe, also in Whittington, near Chesterfield. This method might be used with advantage in connection with distant property by tapping off to overhead mains where required, using the trolley wires as feeders. In such a case we again get back to the overhead mains system, and there would appear no room for doubt but that in this direction will the inventive energies of station engineers find considerable scope.—"G.B.B.," in The Electrical Engineer, London, Eng.

THE YUKON TELEGRAPH SYSTEM.

The annual report of the Minister of Public Works, Ottawa, contains the report of Mr. D. H. Keeley, General Superintendent of the Government Telegraph Service, in which we find an interesting history of that part of the telegraph lines in British Columbia of which the Government became possessed, from their inception to date, and which now form part of the Yukon system, by Mr. J. E. Gobeil, Inspector of Yukon Telegraphs.

Owing to a break in the Atlantic cable, on September 3rd, 1858, it was decided to construct a telegraph line from Washington Territory to Behring straits, thence through a short cable to connect with a land line through Siberia, and connect with the telegraph systems of Europe.

In 1864 the Western Union Telegraph Company constructed a line from Swinomish, Washington Territory, to New Westminster, and in 1865 the line was extended to Quesnel, in Cariboo.

In 1866 the line was continued northeasterly to a point 50 miles north of Fort Stager, on the River Kispyox, a tributary of the River Skeena.

On the successful establishment of the second Atlantic cable, in June, 1866, the project was abandoned. The length from Quesnel mouth to the Kispyox, about 350 miles, was entirely destroyed and hardly a trace of it remained in 1872.

In July, 1868, Barkerville, in Cariboo, was connected with the main line.

On February 11th, 1871, a perpetual lease of the line and appointments was granted by the company to the Government of British Columbia.

One of the terms agreed to as a basis for the political union of British Columbia with Canada was to defray the expenses of the postal and telegraph service, and accordingly on July 20th, 1871, date of the admission of the Province, the telegraph lines were assumed by the Dominion Government.

On September 27th, 1880, the line from Matsqui to Quesnel, 399 miles, was acquired from the Western Union Telegraph Company (being part of the 450 miles of land lines and 16 miles of cable for which the Government paid $24,000).

After 1880, date of purchase, the Government reconstructed the line from Quesnel to Barkerville, 60 miles.

In 1887 arrangements were made with the C. P. R. Telegraph Company to operate the lines between Ashcroft and Barkerville on a percentage basis; and in 1890 the Ashcroft-Barkerville line was repoled.

In 1899 arrangements were made to construct a through line to the Yukon, using the portion of line already built between Ashcroft and Quesnel, and work was commenced on March 28th, 1900.

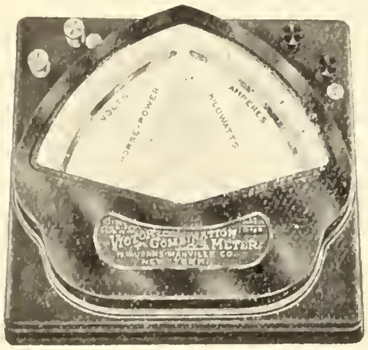
In 1900 the Ashcroft-Quesnel line was again repoled throughout, a new wire being strung thereon for through Dawson business, and the old wire used for local work.

In 1901 the management of the lines, which heretofore had been in the hands of the Canadian Pacific Railway Company, was resumed by the Government, and since then the whole has been operated as a continuous system by the Department of Public Works.

A NEW PORTABLE COMBINATION METER.

The unique combination of a voltmeter, ammeter, wattmeter and horse-power meter in one instrument is accomplished in the "Victor" combination meter, manufactured by the H. W. Johns-Manville Company. This instrument was first placed on the market somewhat over a year ago, and, from the large number of inquiries and orders received, it has evidently filled a long-felt want. It was first designed for switchboard use in central stations, and the success of the instrument for this purpose has resulted in the placing on the market of a portable form for general electrical testing, an illustration of which appears herewith.

The "Victor" meter consists of two separate and complete instruments in a single case, the one giving readings in volts



A New Portable Combination Meter.

and the other in amperes. The third and fourth readings are obtained on a scale plotted at the centre of the dial, giving the product, or power consumption, in watts or kilowatts and horse-power. These readings are taken at the points of intersection of the two indicators. The power scale is calibrated in "watts" or "kilowatts' on one side and "horse-power" on the other.

The convenience of having in one instrument a portable meter giving readings in volts, amperes, watts and horse-power is readily appreciated at a glance, as this meter is adapted for rapid testing in the laboratory, while for field work it is almost indispensable. It has been found especially suitable for taking readings on electric cars, electric elevators, etc.

If desired multiple shunts and extra multipliers will be furnished in connection with the volt and ampere scales for additional readings, and a table, containing the multiplying factor to be used with these various combinations, when reading the central scale.

THE ELECTRICAL WELLS OF THE CITY OF WINNIPEG.

The City of Winnipeg consumes about four and a half million gallons of water daily. This supply is obtained from a system of artesian wells located a short distance beyond the city limits. There are six wells in all, three now in operation and three under construction. Of the latter two are operated by electricity and one by steam.

Wells No. 1 and 2 contain steam driven pumps and have in addition a Worthington horizontal booster pump, driven by a "Form M" 22,000 volt 400 h.p. three-phase variable speed induction motor, supplied by the Canadian General Electric Company.

Wells 3 and 4 are operated by a Canadian Westinghouse type C. C. L. 22,000 volt 313 h.p. induction motor, running at a constant speed of 580 r.p.m. This motor is of a vertical type, direct coupled to a pump of the R. D. Wood Company's manufacture. These two wells give a daily supply of 1 1-2 million gallons.

Well No. 5, now under construction, and well No. 6, which will be completed later, will contain variable speed motors of 313 h.p. each, supplied by the Canadian Westinghouse Company.

The cassions have been sunk down to the limestone rock by the pneumatic process, a 50 h.p. induction motor being installed at each well for the purpose of driving an air compressor.

The plant is supplied with marble switchboards, fitted with ampere and volt meters, oil switches, etc., together with choke coils and lightning arresters. These latter are installed at each well, in addition to a liberal equipment of lightning arresters placed at intervals on the outside lines.

THE MACDONALD ENGINEERING BUILDING FIRE.

An order has been placed with the Electric Repair & Contracting Company, of Montreal, by the authorities of McGill University, to proceed with the necessary repairs to all the apparatus damaged by fire at the time that the Macdonald Engineering Building was destroyed. Already twenty large team loads of apparatus, consisting chiefly of dynamos, motors, transformers, etc., have been removed from the ruins.

DAWSON & COMPANY SUFFER BY FIRE.

The well-known electrical supply firm of J. A. Dawson & Company, Montreal and Winnipeg, suffered severe loss on Friday night, the 26th ultimo, through the almost complete destruction of the Montreal warehouse by fire. The loss is particularly severe, as this is their busy season, owing to the large amount of construction going on throughout the country at the present time. Messrs. Dawson & Company had recently acquired the entire building in which they were located, and were to have taken possession May 1st, the extra space having been necessitated by their largely increased business.

It speaks well for the enterprise of this firm that they had a temporary office in full swing at 9 o'clock the morning following the fire, and have been filling orders for standard material, almost uninterruptedly, obtaining goods from any possible source at almost any figure rather than delay their customers.

J. A. Dawson & Company have secured the large five storey warehouse at 148 McGill street (within a block and a half of their former premises), which they propose to use entirely for their growing business, and they state that they are now in a position to take care of anything that may offer.

In order to avoid delays they have been shipping construction material from their Winnipeg warehouse as far east as Moncton, N.B., as it would have been impossible to procure some of this material within three or four weeks.

As nearly as can be estimated on present information, the probable loss was in the neighborhood of $21,000 or $22,000, which is fully covered by insurance. This, of course, does not compensate the firm for delays and loss of business, but Messrs. Dawson & Company advise us that the other electrical supply companies in Montreal have practically placed their stocks at their disposal for the filling of current orders, which has enabled them to fill same almost without delay.

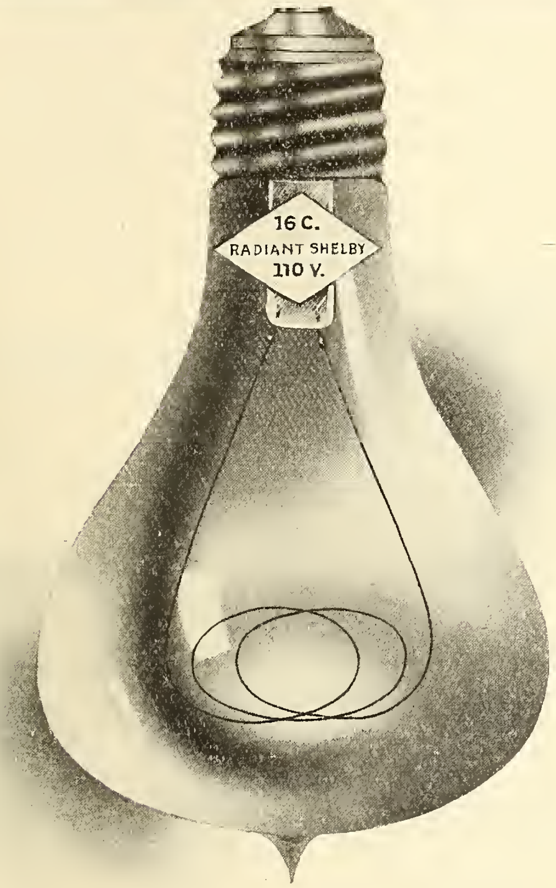
New stock was ordered by telegraph while the building was still burning, and the larger manufacturers, realizing the conditions, gave their orders preference, and a large quantity of this material is now in the city. As a consequence, five days after the five they are in a position to fill almost any order, which we consider a remarkable showing in the face of adverse conditions.

The Bell Telephone Company have secured a three years' exclusive franchise in the city of London, Ont.

The Kamouraska Telephone Company has been authorized to increase its capital stock to $250,000 and to extend its telephone lines in the counties of Rimouski and Matane.

The Canadian General Electric Company have lately issued an attractive booklet illustrating and describing the works of their company at Peterboro', and the factory of the Canada Foundry Company, Toronto, the author being Augustus Bridle.

The new office building which the Canadian General Electric Company are erecting on the northwest corner of King and Simcoe streets will, we understand, be 185 x 65 feet and five stories high, and will be used exclusively as offices and showrooms for the Canadian General Electric Company and Canada Foundry Company.



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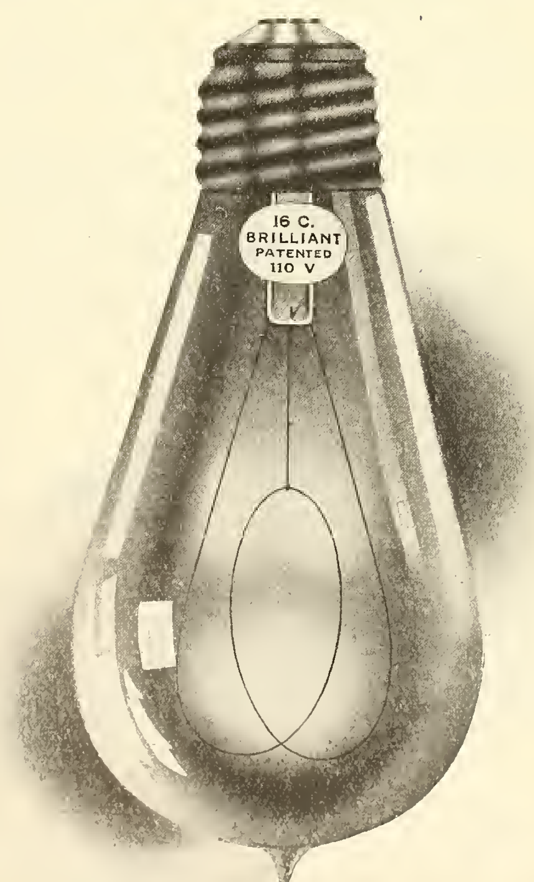

SPARKS.

The Northern Electric Company, of Montreal, will supply a fire alarm system for the city of Strathcona, Alta.

A by-law was recently carried by the ratepayers of Calgary, Alta., providing the sum of $35,000 for the purpose of extending the electric lighting system.

Pittsburg capitalists are said to be negotiating for the control of the Brantford Street Railway Company and the Grand Valley Railway Company. If acquired, extensive improvements will be undertaken.

Tenders for the supply and installation of an electric lighting plant for the town of Battleford, Sask., closed on the 10th inst., and the contracts will be awarded immediately. Messrs. Galt & Smith, Toronto, are the engineers.

The by-law granting a five year exclusive franchise to the Bell Telephone Company was carried by the Ottawa City Council last month, with an amendment to the effect that two years before the expiration of the franchise the city may put in conduits or poles in preparation for the establishment of a municipal system, or may authorize another company to do the same.

SPARKS.

Mr. John Galt., C.E., has reported on the development of electric power at Shuswap Falls, about 30 miles from Vernon, B.C. He estimates that 5,000 h.p. can be developed at a cost of $250,000, and if only 600 h.p. be taken at $30 per h.p a sufficient revenue could be obtained to cover interest charges and operation.

A company is being formed, composed of Ottawa, Arnprior and Renfrew parties, to develop a valuable water power on the Mississippi river at Galetta, Ont. The deal for the water power was put through by Mr. J. J. Ringrose, of Galetta. It is understood that the new company will immediately develop the falls and build their transmission line to Arnprior.

A modern electric light and waterworks system has been installed at Banff, Alberta. There are two generators, one of 200 kw. capacity and one of 70 kw., supplied by the Canadian General Electric Company and directly connected to the engine. The waterworks equipment comprises two large duplex fire pumps, two deep well pumps and two condenser pumps, made by the Canada Foundry Company, Toronto.

The Sherbrooke Street Railway Company and the Sherbrooke Power, Light & Heat Company are considering a proposition to amalgamate. Among points which it was suggested would enter into a contract with the city in connection therewith are the following: The street lighting would be continued as at present. The company would agree to provide up to 500 h.p. yearly at cost, to be paid for by the city, but only for bonuses to new industries locating there. The city would retain the right of owning and operating an electric power plant, but solely in order to furnish power to take the place of a cash bonus to new industries and in order to light the streets and city buildings. The arrangement would be liable to termination by the city at the end of two, three, four or five years, by three months' prior notice in writing.

SHAWMUT POCKET TEST LAMP.

Attention is called to the Shawmut Pocket Test Lamp, a device recently put on the market by the Chase-Shawmut Company.

The considerable difficulty and annoyance which has occurred from defective indicators of enclosed fuses in general, necessitating the employment of cumbersome methods to determine blown fuses, led the Chase-Shawmut Company to design a test lamp to be used as a short-cut method of discovering same. It is also very useful to show whether or not a circuit is alive. It is made up of a specially designed incandescent lamp, enclosed in a fibre casing. This casing has ferrules and knurled binding posts on either end, while at the middle a fair sized hole through both walls of the casing allows the illumination of the lamp to be plainly seen. For the majority of switches and fuses the metal ends of the test lamp will bridge parts of opposite polarity, but for work where the distance is greater than the length of the test lamp the binding posts afford a convenient means of clamping leads of sufficient length. It is not designed for continuous service, and should be used only for flashing, as the small enclosed casing will soon become too hot if left long in circuit.

The test lamp is made in two sizes; one for 110 volts, measuring 3 7-8 in. over all, with a diameter of 11-16 in. The other, for 220 volts, measuring 4 3-4 in. over all, with a diameter of 1 1-16 in.

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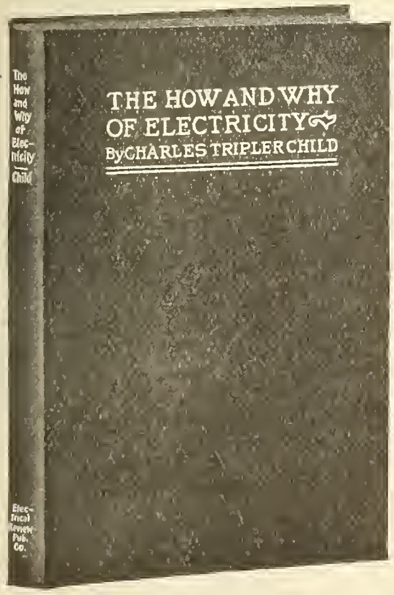

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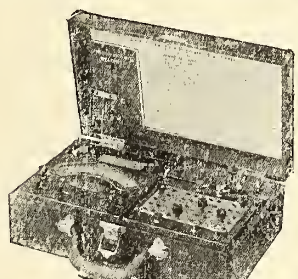

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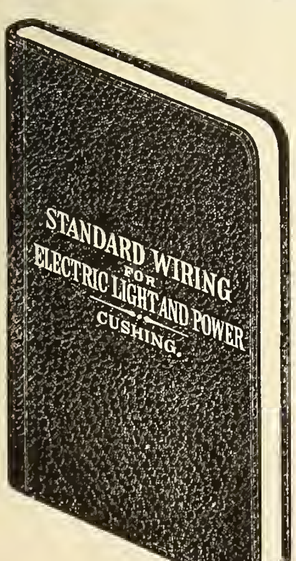

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TRADE NOTES.

Messrs. Collyer & Brock, electrical engineers and contractors, Montreal, have removed to the Desbarats Building, corner of Beaver Hall and Lagauchetiere streets.

Damage to the extent of $3,000 was recently sustained by Fred. Thompson & Company, electrical contractors, Montreal, as the result of a fire, supposed to have been caused by spontaneous combustion.

The engineering and contracting firm of Westinghouse, Church, Kerr & Company, has been incorporated in Canada under the name of Westinghouse, Church, Kerr & Company of Canada, Limited. It is understood that considerable Canadian capital will be invested in the Canadian corporation.

The Midland Electric Company, electrical specialties, Montreal, announce their removal from 60 St. Peter street to more commodious quarters at 119 to 121 D'Youville Square, where they are displaying a larger line of bronze, terra cotta, amphora and bisque electroliers and portables, "Beaver Standard" lamps, etc.

In order to keep pace with the requirements of their increase in business, the John McDougall Caledonian Iron Works Company, Limited, of Montreal, have opened sales offices at the following places:—Montreal, 82 Sovereign Bank Building; Toronto, 810 Traders Bank Building; Winnipeg, 251 Notre Dame street; Vancouver, 416 Seymour street; Nelson, Josephine street; New Glasgow, N.S., Telephone Building. Their principal products are waterworks equipment and all kinds of hydraulic and mill machinery.

PERSONAL.

Mr. Charles Garden, Woodstock, N.B., has gone to Vancouver, B.C., to become engineer for the British Columbia Electric Railway Company.

Mr. H. D. Bayne, of the Canadian Westinghouse Company, Montreal, sailed from St. John, N.B., April 6th, for a two months' trip on the European continent.

A well-known engineer passed away on April 11th in the person of Mr John M. Dixon, who was for a number of years engineer at the City Hall, Toronto.

Mr. Charles F. Wolfe, who has been with the Waterous Engine Company, Brantford, for 35 years, and recently as general superintendent, has resigned, to become associated with the Canadian Casualty & Boiler Insurance Company, of Toronto.

Mr. T. McCrossan, city electrician of Vancouver, B.C., has tendered his resignation, owing to the Council's refusal to increase his salary. Mr. McCrossan has performed his duties very satisfactorily and has placed his department in a strong position.

Mr. P. E. Hart has been engaged as electrical engineer by the town of Kenora, Ont., and will have charge of the lighting, power and telephone systems. Mr. Hart was first engaged in America with the General Electric Company, of Schenectady, N.Y., in their testing department, afterwards with the West Kootenay Power & Light Company, of Rossland, B.C., and later with Allis-Chalmers-Bullock, Limited, of Montreal.

PUBLICATIONS.

Frederick J. Drake & Company, publishers, Chicago, have placed on the market a book of 300 pages, entitled "Locomotive Engine Break-downs and How to Repair Them." It consists chiefly of questions that were asked by enginemen during a series of years and answered by Mr. W. G. Wallace through the columns of the Brotherhood of Locomotive Firemen's Magazine.

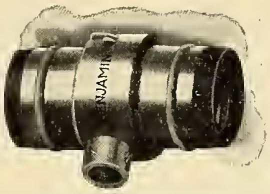
Bulletin No. 6, from the Weston Electrical Instrument Company, Waverly Park, Newark, N.J., describes the Weston multimeter, which is a new form of electrical measuring instrument, possessing a very wide range of usefulness in the measurement of electrical quantities. It is an instrument which will quite accurately serve the purposes of a direct current voltmeter, milli-voltmeter, ammeter, mil-ammeter, ohmmeter, ground detector and wheatstone bridge.

CANADIAN

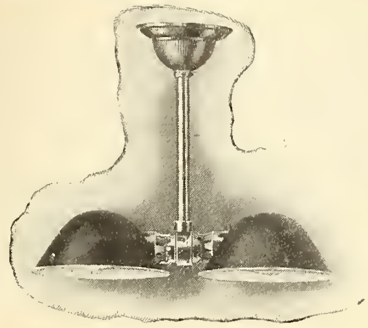
Electrical News

AND ENGINEERING JOURNAL

SEVENTEENTH YEAR. No. 6. | TORONTO, MONTREAL — JUNE, 1907 — WINNIPEG, VANCOUVER | PRICE 10 CENTS $1.00 PER YEAR.

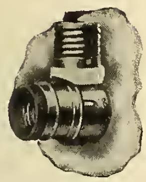


Cat. No. 412—2-Light.



Twin Socket with Parabolic Shades, Pendant Form
Cat. No. 043272.

Cat. No. 411—1-Light.



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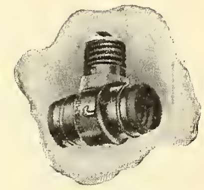

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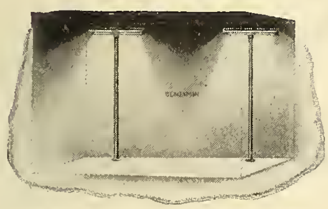
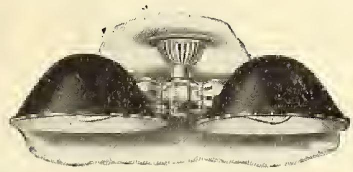
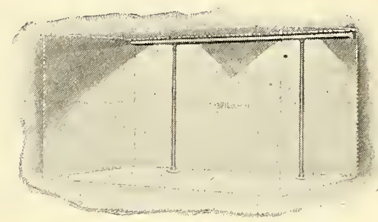


Column Light—Cat. No. 4282.



Twin Socket with Parabolic Shades,
Pendant Form—Cat. No. 482742.



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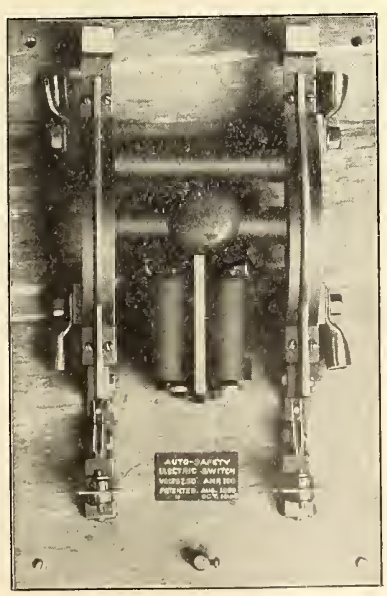

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MOONLIGHT SCHEDULE FOR JULY

Date.	Light.	Date.	Extinguish.	No. of Hours.
July 1	8 10	July 2	1 30	5 20
2	8 10	3	2 00	5 50
3	8 10	4	2 30	6 20
4	8 10	5	3 00	6 50
5	8 10	6	3 30	7 20
6	8 10	7	3 40	7 30
7	8 10	8	3 40	7 30
8	8 10	9	3 40	7 30
9	8 10	10	3 50	7 40
10	8 00	11	3 50	7 50
11	8 00	12	3 50	7 50
12	8 00	13	3 50	7 50
13	8 00	14	3 50	7 50
14	8 00	15	3 50	7 50
15	8 00	16	3 50	7 50
16	8 00	17	3 50	7 50
17	10 00	18	3 50	5 50
18	10 30	19	3 50	5 20
19	11 00	20	4 00	5 00
20	11 45	21	4 00	4 15
22	0 30	22	4 00	3 30
23	1 20	23	4 00	2 40
24	No Light	24	No Light	
25	No Light	25	No Light	
26	7 50	26	10 15	2 25
27	7 50	27	11 00	3 10
28	7 50	28	11 30	3 40
29	7 50	30	0 00	4 10
30	7 50	31	0 30	4 40
31	7 50	Aug 1	1 00	5 10
			Total	166 30

The Brandon Electric Light Company, Brandon, Man., have commenced an addition to their power house. The present building will be carried out to the corner of Lorne avenue and a new addition erected three stories high, brick, with cement and stone foundation. When the new machinery is installed the capacity of the plant will be greatly increased.

Please mention the CANADIAN ELECTRICAL NEWS when corresponding with advertisers.

SPARKS.

Mr. C. H. Mitchell, C.E., of Toronto, has recently reported on a water power project in the vicinity of Saskatoon, Sask.

Mr. L. White, formerly of Calgary, has been engaged as superintendent of the civic electric light plant at Saskatoon, Sask.

The Stark Telephone, Light & Power System, Limited, Toronto, have removed their head office from the Manning Chambers to 84 King street east.

Messrs. Ross & Holgate, consulting engineers, Montreal, have been engaged by the City of Ottawa to report on the several water powers available for use by that city.

The Nipissing Central Railway Company propose to construct an electric railway from Cobalt to New Liskeard, Ont. Hon. Frank Latchford is interested in the company.

The electric light plant at Fort Saskatchewan, owned by O. Higman, has been sold to a joint stock company, known as the Fort Saskatchewan Electric Company, Limited.

The City of Woodstock has applied to the Ontario Railway & Municipal Board for the approval of a by-law providing for the issue of debentures to the extent of $7,045 for the extension of the electric light plant.

The Bell Telephone Company have decided to install an entirely new plant at Chatham, Ont. They have leased a new building, which will be modernly equipped, and it is probable that an underground system of wires will be adopted.

Mr. H. G. Acres, electrical engineer, Toronto, has reported on a water power at Wardsville, Ont., the development of which is under consideration. By the building of the dam a fall of twenty-eight feet can be obtained, which will give from 500 to 800 horse-power.

The Toronto Board of Control have decided to instruct the City Engineer to make an estimate of the cost of a distribution plant, also to report where the distributing station should be located. The report will be submitted on the basis of the city taking 15,000 horse-power.

Mr. A. C. Reid, city electrician of Moose Jaw, Sask., will ask the Council for $30,000 for necessary extensions to power house and plant. The improvements contemplated include a new boiler house, new steel stack, two new boilers and a third generating unit. This latter, however, may not be required until next year.

The Town Council of East Toronto have granted a franchise to the Independent Phone Company, and the question of terms is now being arranged. It is probable that there will be a maximum rental of $15 per year for house phones and $24 for business phones, with a free service to subscribers of York, Markham, Scarboro', etc., where the independent lines are now operated.

The City Council of Quebec have awarded the contract for electric lighting as follows:—Quebec Jacques-Cartier Electric Company, direct current enclosed arc lamps, at $62.10 for a period of five years; 65 candle power incandescent lamps, $24 a year. Quebec Railway, Light & Power Company, for lights in the parks, direct current enclosed arc lamps at $40 a year for a period of five years; 65 candle power lamps, $10 a year.

The Strathcona Radial Tramway Company, Limited, are desirous of securing a franchise in Strathcona, Alta., for the operation of a street railway system. The company is composed of Edmonton and Strathcona capitalists, their solicitors being Rutherford & Jamieson. They ask an exclusive franchise for thirty years, the city to have the option of acquiring the railway system at the expiration of that time. They agree to have three miles in operation by November 1st, 1909. The motive power is to be electricity.

It is understood that the British Columbia Electric Railway Company find it necessary to provide additional power at Victoria, and that Mr. Meredith, the eminent hydraulic engineer, has been engaged to report on the various water powers available. It has been suggested that water be diverted from the Koksilah River by means of a pipe line. This would be utilized for maintaining the level of Shawinigan Lake. Then from the latter body of water would be constructed an outlet to a point in the vicinity of Mill Bay, where the power house would be located. This project would involve a large expenditure of money, but it would provide a supply for many years to come. All will depend on the report of Mr. Meredith.

SPARKS.

The Hydro-Electric Power Commissioners are considering the advisability of sending one of their experts to Europe with a view to examining into the latest systems adopted there for the long-distance transmission of large units of electrical energy.

The Railway and Municipal Board have given their approval to the adoption of the Providence fender by the Peterboro' Street Railway. Mr. J. H. Larmouth, C.E., a graduate of McGill, has also been approved by the Board as local examiner of motormen for the same city.

Mr. Wm. N. Rumley, president of the Rumley Manufacturing Company, of La Porte, Indiana, was in Toronto last month, and arranged with the American-Abell Engine & Thresher Company for the manufacture of his invention of a new boiler, on which he has secured Canadian patent No. 98616.

SPARKS.

The Norton Telepohne & Contracting Company, Limited, has recently been incorporated at Toronto to manufacture and deal in electrical supplies and the Norton system of hotel annunciators and telephones. The capital is $10,000.

The West Kootenay Power & Light Company have purchased the plant and other assets of the Cascade Water Power Company in order to supply their customers in the Boundary district with electric power. The Cascade Company have furnished power in the Boundary district since 1901, but the amount has been inadequate to meet the demands of the district. The West Kootenay Power & Light Company extended their pole lines to Grand Forks, Phœnix, Greenwood and other points at a large expense, but the Legislature of 1906 refused to give them permission to sell power in the Boundary district, on the ground that the Cascade Water Power Company had the exclusive right within a certain radius of the works at Cascade. The negotiations which have just been concluded now gives the West Kootenay Company the right to sell electric power in two of the largest mining districts in British Columbia.

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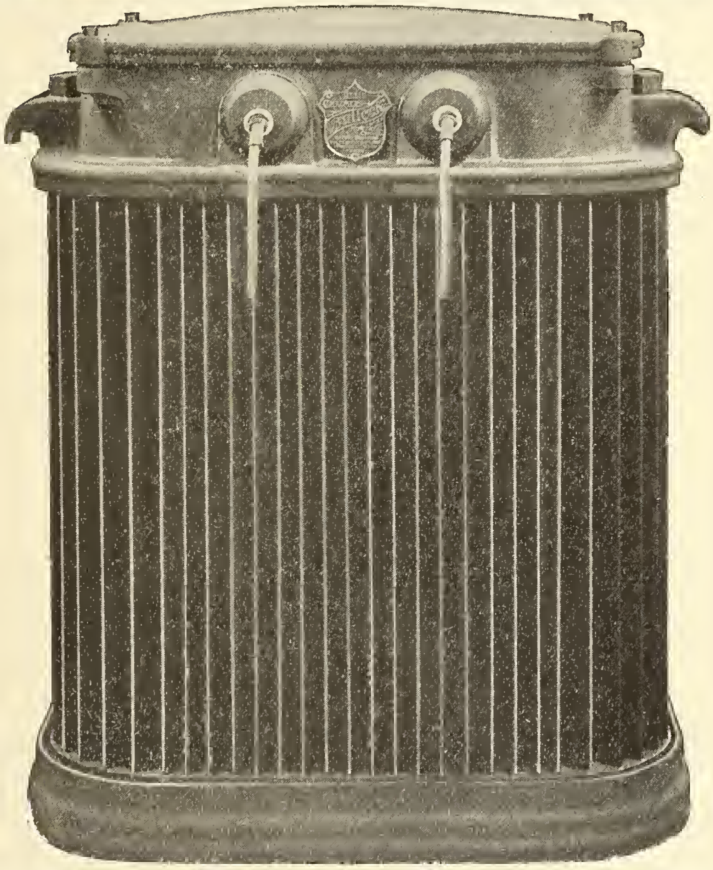
Transformers

ALLIS-CHALMERS Bullock LIMITED MONTREAL



For the standard line of lighting transformers, Allis-Chalmers-Bullock, Limited, employ the "core" type now almost universally recognized as the best all-round type for lighting service. These transformers are oil-filled, self-cooled. Cast iron tanks are used up to 10 K.W. The cases above 10 K.W. are made of corrugated terne sheet. For further particulars see Bulletin 300.

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Synchronous Motors.
Transformers.
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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

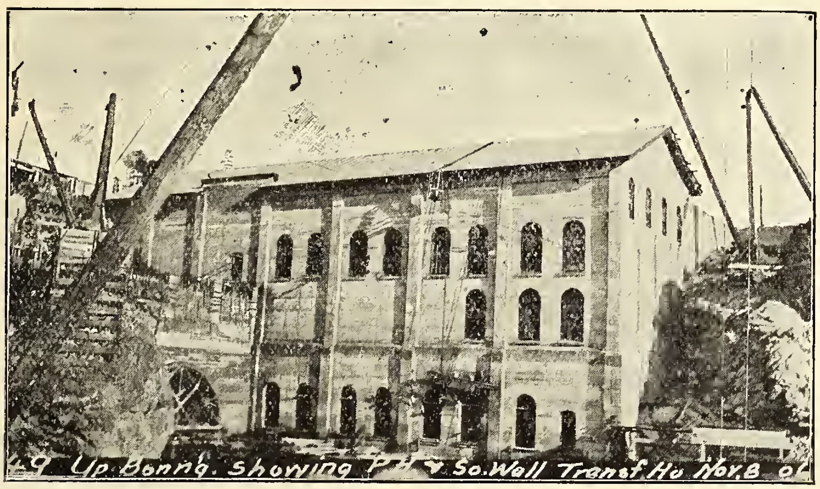
Vol. XVII. JUNE, 1907 No. 6

Power Development on the Kootenay River for the West Kootenay Power and Light Company, Limited.*

By Robert A. Ross and Henry Holgate, Members Can. Soc. C. E.

The Kootenay River rises in the northern part of Windermere, in British Columbia, a short distance east of the head waters of the Columbia River, and flows southerly parallel to the north-flowing waters of the Columbia for fifty miles, thence through Fort Steele and across the international boundary into United States territory, flowing south and northwest for a distance of about 120 miles. It then enters Canadian territory again, and soon expands into what is known as Kootenay Lake, which receives a number of small streams in its northern arm The lake discharges by way of the west arm, at the western end of which is the town of Nelson; the river keeps a southwesterly course to its junction with the Columbia River at Robson. The total length of the river is about 350 miles, and the area drained by it and its tributaries, above a point ten miles below Nelson, is some 9,800 square miles, of which 2,500 square miles are United States territory.

The minimum flow of the river, at a point about nine miles below Nelson, was found to be 5,850 cubic feet per second. These measurements were taken in January, 1905, when the water in the river was lower than at any season previously observed. The variations in flow of the river are very great but no measurement of maximum flow has been made as far as is known. The periods of high and low water differ from those of rivers not situated in mountainous country, and, in the case of the Kootenay River, which largely depends for its supply from the masses of melting snow on mountains of great altitude, the high water period is comparatively late in the season, highest water being in June and July.



West Kootenay Power Development—Downstream View of Power House.

The power development herein described was built at the Upper Bonnington Falls, the lower falls having been partially developed some years ago by the same company. The site for the development of the upper falls was chosen on the north bank of the river.

The channel between the Rocky Island and the north bank was made use of for approach and tail race; the power house was built in the river, and a cofferdam was built from the bank to the island, thus unwatering the whole site and diverting the water to the south of the island. Although the natural channel assisted materially in the development work, yet about 40,000 cubic yards of rock had to be removed to provide power house foundations and tail race. The removal of this rock was somewhat difficult, owing to the confined area in which the work had to be done, the difficulty of disposing of it, the nature of the rock (Nelson granite) and the irregularity in direction of the seams in the rock, some of which had to be

*Abstract of a paper read at a joint meeting of the Mechanical and Electrical Sections of the Canadian Society of Civil Engineers, Montreal, May 9, 1907.

excavated under water. As a large part of the concrete work admitted of the use of large stones, those most suitable for the work were piled up in convenient places for this purpose, and a large quantity was passed through crushers and used in the concrete.

The variations between high and low water above and below the falls do not correspond the reason being that at present the flow of the river below the falls is restricted by a number of rocky islands. These hold back the flow of the stream, but it is the intention to improve this channel, so as to afford more channel area and more nearly equalize the rise and fall below the falls with the rise and fall above them.

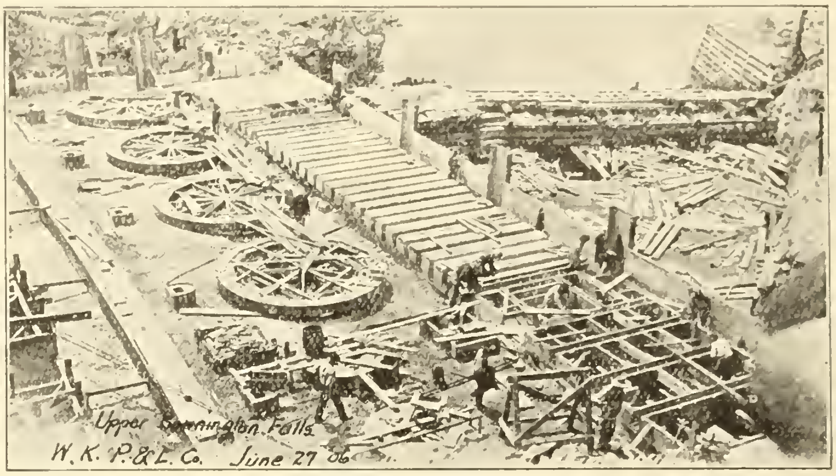
Owing to these variations, which can never be entirely eliminated (except at a cost beyond commercial practicability), the vertical type of wheel setting was adopted, using all the head available at all stages of water, instead of adopting a head which would be nearly constant and which would involve the sacrifice of a large amount of power for periods when low water prevailed. Of course, when the natural head is least, the volume of water used is not important, as the quantity available is more than ample, but at periods of low water the head is greatest, and the vertical setting is an advantage, since it permits the use of the higher head. Had a horizontal wheel setting been adopted, the power house floor would have had to be set above highest water, and allowing the use of a draft tube of 24 feet at this altitude, the tail water would have had to be maintained at a level above low water, which would involve the loss of head for a considerable period of every year when water was low and, consequently, when head was most valuable.

It is the intention to increase the natural head by building a timber dam across the river to a height that will drown the rapids above the fall thus affording an increase of head of ten feet, and the machinery and works are designed to meet this condition. This work will be done during the current year. There are no troubles from ice on this river.

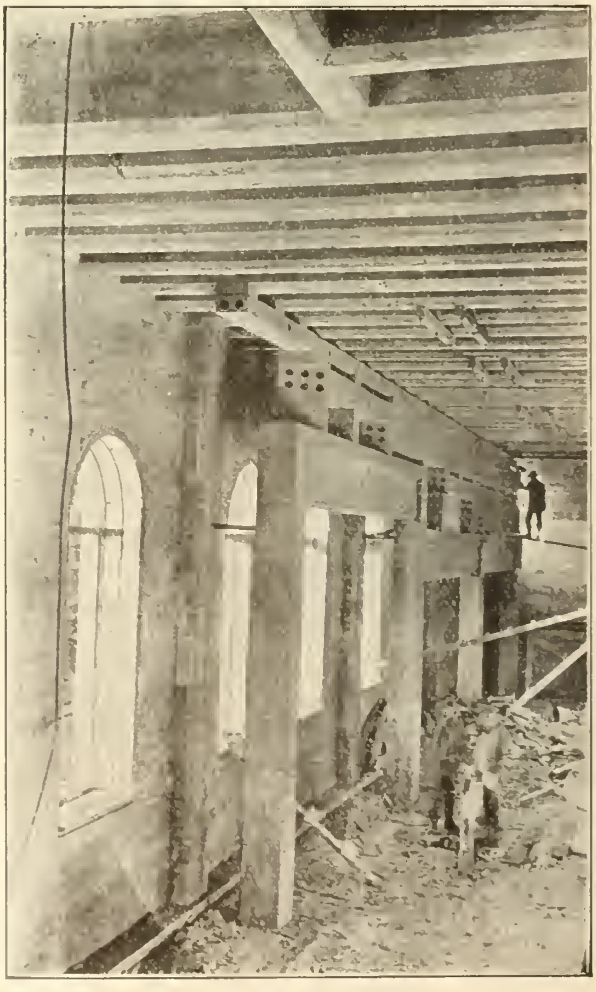
It is possible to construct works at the outlet of the Kootenay Lake to maintain the lake level more nearly uniform, and thus to assist materially in reducing maximum discharge and increasing minimum discharge of the river below this point. This will render working conditions much better and increase the potentiality of the river considerably. However, the matter has not yet been considered by the Government, though it would afford advantages of public benefit in the navigation of the lake, which is now, and will perhaps always be, a part of the transportation system of this district, owing to the great difficulty of constructing a railway from Kootenay Landing to Proctor, located 17 miles above Nelson.

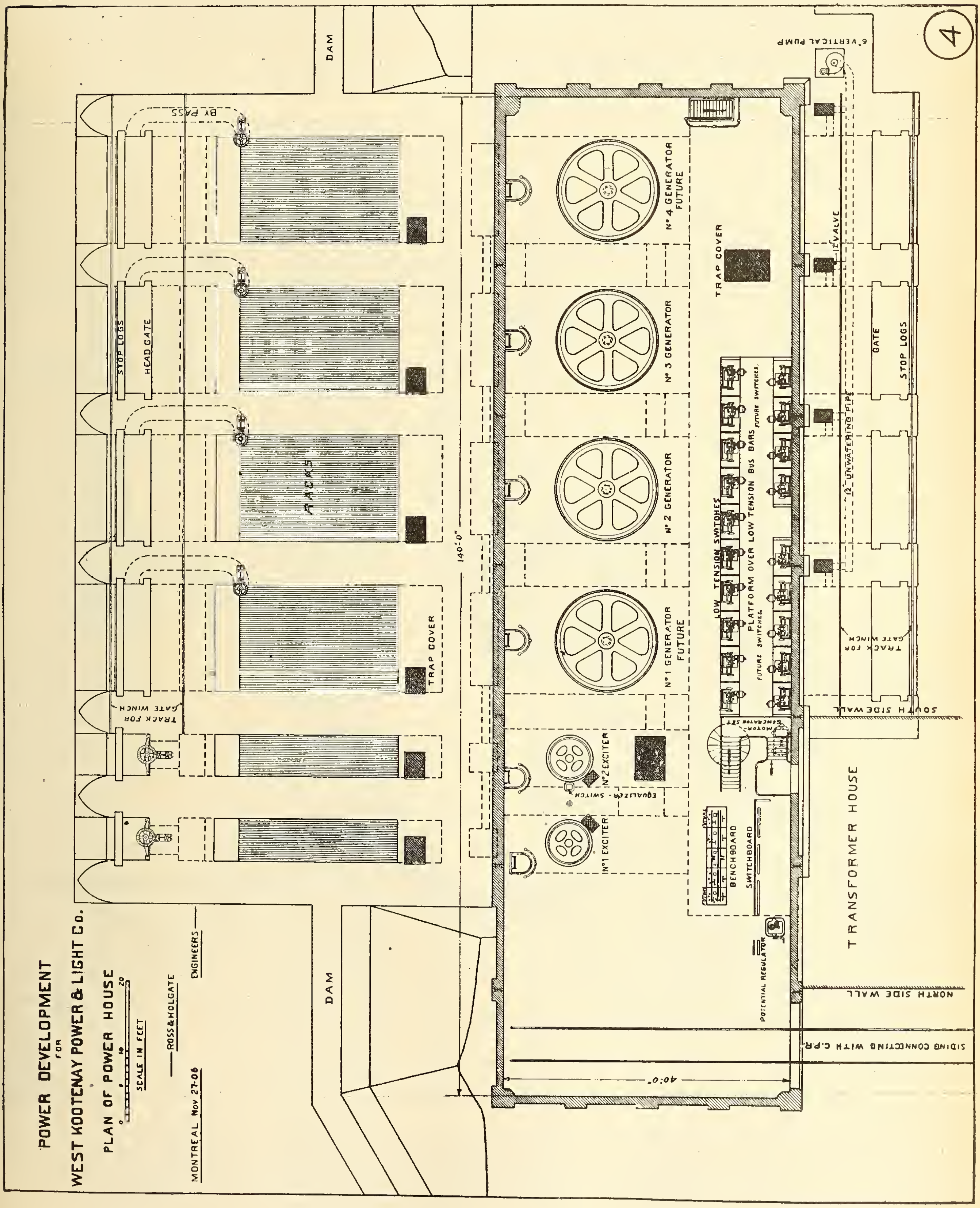
The power house is entirely of monolithic concrete construction reinforced wherever necessary; the reinforcement consisting of round steel rods, and in some places of steel rails, which were used in parts of the structure under severe strain.

The general scheme can readily be seen by referring to plan herewith. The water enters the flume through



West Kootenay Power Development—Generator Floor in Construction.


Kootenay Power Development—Pump Chamber and Duct System.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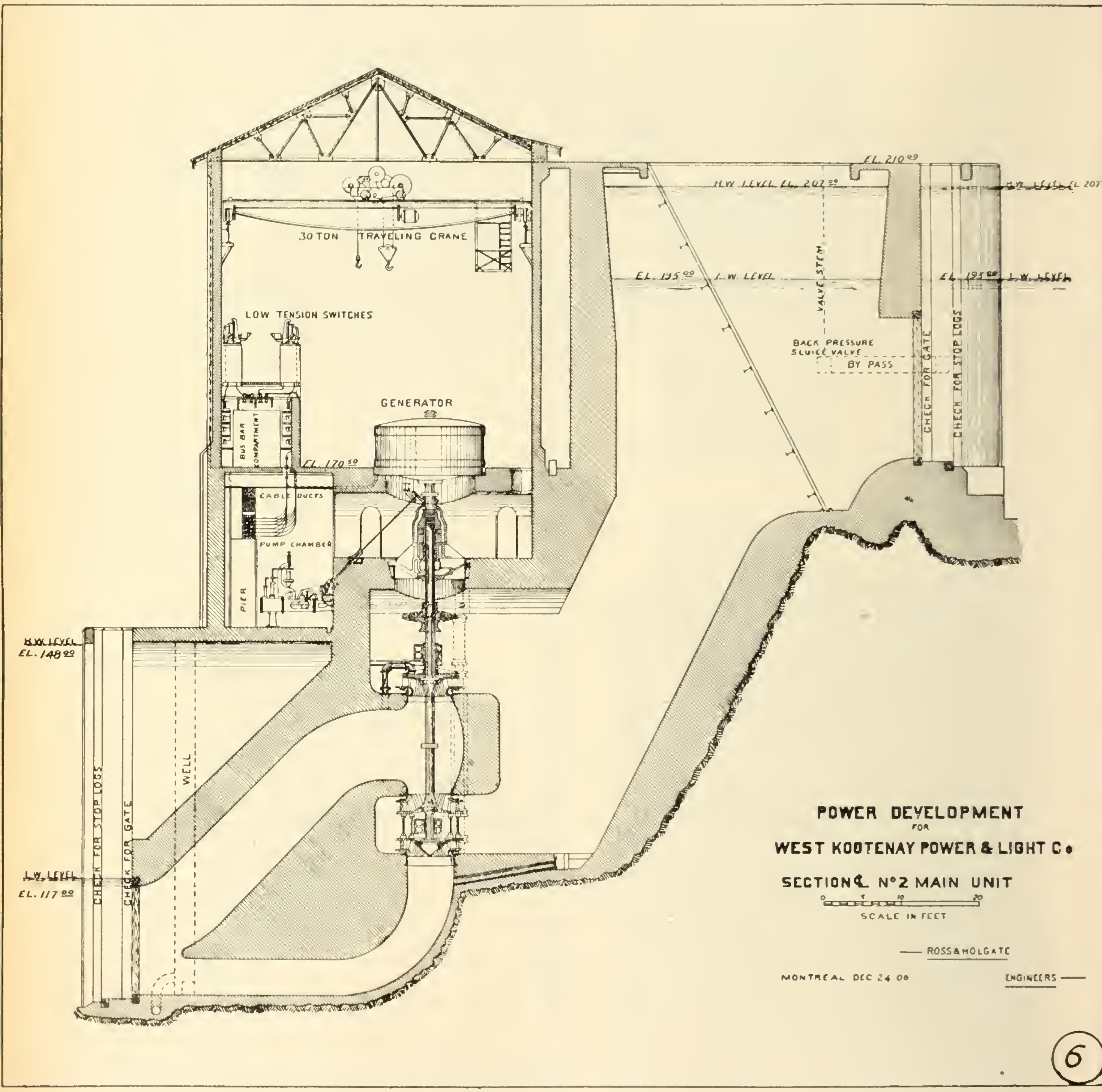
POWER DEVELOPMENT
FOR
WEST KOOTENAY POWER & LIGHT Co.
PLAN OF POWER HOUSE
0 5 10 20
SCALE IN FEET
ROSS & HOLGATE
ENGINEERS
MONTREAL Nov 27-06
DAM
DAM
BY PASS
STOP LOGS
HEAD GATE
RACKS
TRAP COVER
TRACK FOR GATE WINCH
140'-0"
40'-0"
No 4 GENERATOR FUTURE
No 3 GENERATOR
No 2 GENERATOR
No 1 GENERATOR FUTURE
No 2 EXCITER
No 1 EXCITER
EQUALIZER - SWITCH
TRAP COVER
LOW TENSION SWITCHES
PLATFORM OVER LOW TENSION BUS BARS
FUTURE SWITCHES
MOTOR GENERATOR SET
BENCHBOARD
SWITCHBOARD
POTENTIAL REGULATOR
6" VERTICAL PUMP
12" VALVE
12" UNWATERING PIPE
GATE
STOP LOGS
TRACK FOR GATE WINCH
SOUTH SIDE WALL
TRANSFORMER HOUSE
NORTH SIDE WALL
SIDING CONNECTING WITH C.P.R.

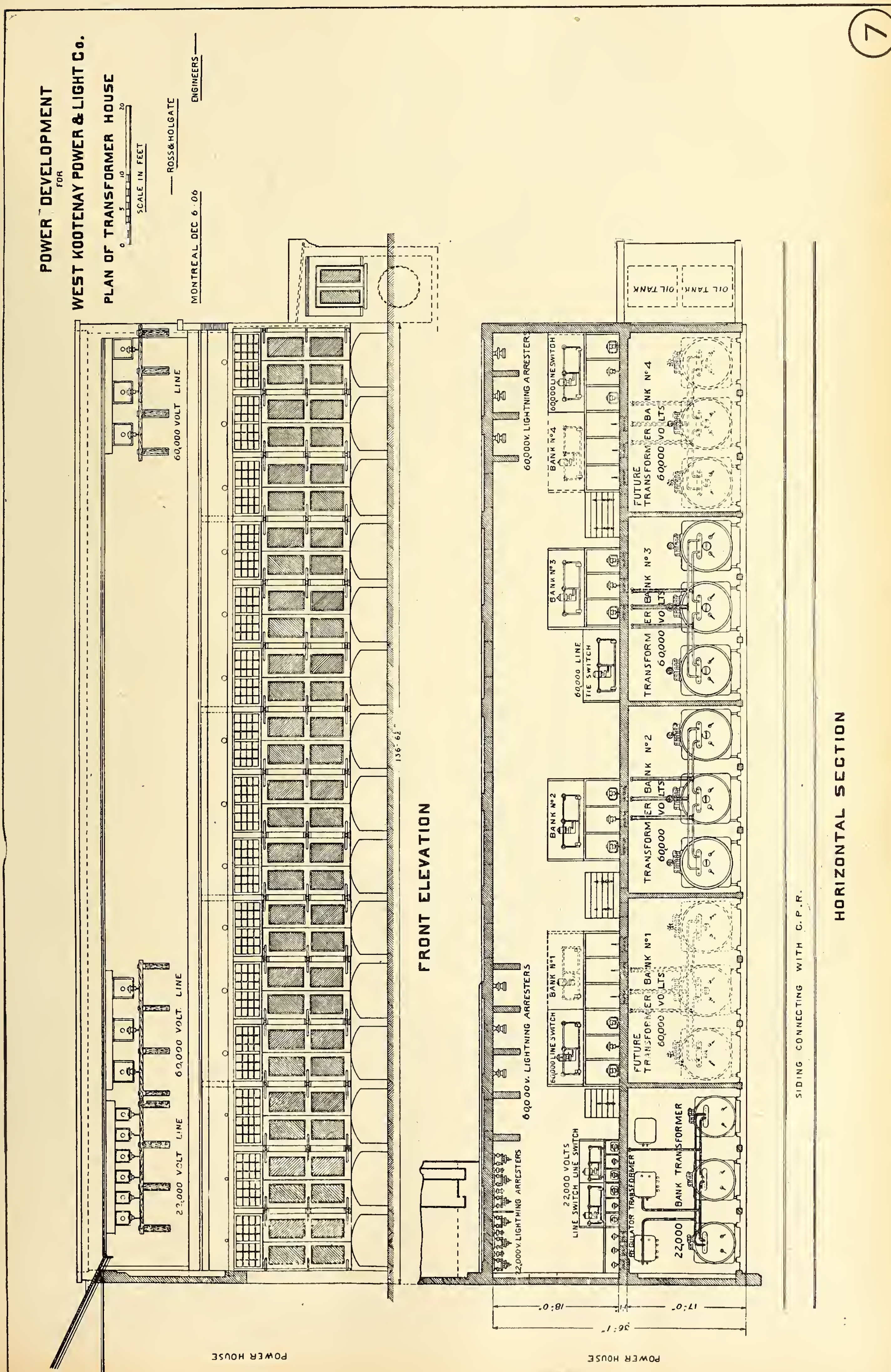
the submerged openings between the piers, and can be shut off by gates or by stop logs, the latter being provided for, so as to render the gate accessible in case of emergency. Behind the gates are the screens, which are thus rendered accessible for repairs or cleaning, if necessary. The water flows down the tube formed in the concrete to the wheels, of which there are three on each shaft, two discharging into the upper draft tube and one into the lower tube, uniting in a common discharge, which is placed below low water. The draft tubes are moulded in concrete and have no steel lining, being built up with the structure, cored openings in the monolith. Care was taken to secure a very smooth surface on the inside of all passages for water, and their curves and cross sections were designed to offer as little resistance as practicable.

The exciter turbines are similarly arranged, but are made to operate under a constant head by having the discharge at a higher level, which level is maintained by a weir.

The pressure pumps, governors, and low tension cables are all located in the chamber below the power house floor, the only machinery on the floor being the generators, controlling board and the low tension switches. The crane travels the length of the power house and over the railway track, so that all machinery can be handled from the car to place by the crane. Any leakage through the up-stream wall is taken care of in the air space and drained off.

The tail race openings are also provided with gates and stop logs, which can be closed, and any chamber can be emptied of its water by a system of drains and valves, leading the water from any one chamber to a well at the south end of the building, where a centrifugal pump throws it out into the tail race. The




POWER DEVELOPMENT FOR WEST KOOTENAY POWER & LIGHT Co.
PLAN OF TRANSFORMER HOUSE
SCALE IN FEET
ROSS & HOLGATE ENGINEERS
MONTREAL DEC 6 06
60,000 VOLT LINE
22,000 VOLT LINE
FRONT ELEVATION
136'-6½"
OIL TANK
60,000 V. LIGHTNING ARRESTERS
22,000 V. LIGHTNING ARRESTERS
60,000 LINE SWITCH
BANK No 1
BANK No 2
BANK No 3
BANK No 4
60,000 LINE TIE SWITCH
22,000 VOLTS LINE SWITCH
REGULATOR TRANSFORMER
22,000 BANK TRANSFORMER
FUTURE TRANSFORMER BANK No 1 60,000 VOLTS
TRANSFORMER BANK No 2 60,000 VOLTS
TRANSFORMER BANK No 3 60,000 VOLTS
FUTURE TRANSFORMER BANK No 4 60,000 VOLTS
18'-0"
17'-0"
36'-1"
POWER HOUSE
SIDING CONNECTING WITH C. P. R.
HORIZONTAL SECTION
7

head water is admitted through a by-pass. The whole scheme provides the greatest facility for inspection and making of repairs when necessity arises.

The transformer house is shown on plan No. 7. The floor of the transformer room is at such a level as to permit of the transformers being wheeled on their own trucks from a flat car on the railway siding into place. The transformers are entirely separated from the switch room by a concrete wall, and the whole building is of concrete, including the partitions and barriers.

Owing to the peculiar location necessary for the transformer and switch building in relation to the power house, it was necessary to throw arches over a gap in the rock to provide foundation for the building.

As this work is the largest single piece of concrete construction yet built in the Province, it is satisfactory to be able to say that the whole of the cement used was manufactured in British Columbia, and successfully passed the rigid tests of the engineers prior to acceptance.

Hydraulic Machinery.—Each main unit is capable of delivering to its electrical generator 8,000 mechanical horse-power when operating under a head of 70 feet of water and when running at a speed of 180 revolutions per minute. The quantity of water required per unit is 1,260 cubic feet per second, or a volume equal to the flow of a river 100 feet wide, 5 feet deep, and moving with a velocity of 151.2 feet per minute.

Each 8,000 horse-power turbine consists of three inward flow Francis runners mounted on a vertical shaft, each runner being equipped with its own distributor and movable guide vanes. These distributors are bolted to heavy cast iron base rings secured to the masonry. The runners are thus mounted in concrete pits, which form the turbine wheel casings and the draft tubes for carrying the discharge water to the tail race.

The runners are made of special turbine metal of approximately 88 parts copper, 10 parts tin, and 2 parts zinc. Each is made in one piece, cast in cores and bolted to the hub. The hubs are made by enlarging the shaft at the points where the runners are attached, and heavy flanges are turned on the shaft above the hubs, to which the runners are securely bolted.

The upper and intermediate runners discharge in opposite directions into a common draft tube, the upper one discharging downward. The lower runner, like the upper one, discharges downward also, but into its own individual draft tube. The chamber above the upper runner is by-passed to the draft tube, which relieves the pressure in the chamber, and thus eliminates the hydraulic thrust of this runner. As the other two runners discharge in opposite directions, the total resultant thrust on the shaft is theoretically zero. The thrust bearing, however, has been designed to take care of a generous amount of thrust over and above the dead weight of the revolving parts. The revolving parts consist of the rotor of the generator, the shaft in three sections, three runners weighing 4,000 pounds each, couplings and bolts, making a total of 170,000 pounds. The thrust bearing consists of two specially close-grained cast iron discs. The lower disc is supported by a ball seat, while the upper is securely held in place by an adjusting nut on shaft. The discs have raised lips on the outside and inside circumferences, so as to form an annular pressure chamber, into which the oil is forced under a pressure of 250 pounds, which lifts the revolving parts. When these parts are lifted the oil escapes between the surfaces of the discs, by this means supporting the total weight on a film of oil.

The thrust bearing is covered with a cover, fitted with glass peep holes. The oil is supplied to the bearing from a high pressure triplex pump, capable of working under a pressure of 500 pounds per square inch. This pump is directly driven from the main turbine shaft by bevel gearing and counter shaft. Each turbine has its own pump, oil tank, piping, guages, etc., which, in fact, is a complete system in itself, and independent of the governor system.

An extra motor-driven pump, with piping, has been provided, which is arranged to act as a spare for any one of the main units or exciters, but its primary use is to supply oil to the turbines when starting up.

The main turbine shaft is kept in alignment by three guide bearings. The upper guide bearing is built in conjunction with the thrust bearing. It is lined with Parson's white brass and is lubricated by oil supplied under pressure.

The intermediate and lower guide bearings, the former situated above the upper runner, and the latter between the intermediate and lower runners, are of lignum vitæ, made by driving lignum vitæ into the dovetail spaces in the bronze boxes. As these bearings are submerged, they are well lubricated with water and require little or no attention.

The water is distributed to the runners through malleable iron movable guide vanes finished smooth, so as to offer little resistance to the water. These vanes are operated by means of links from one side of the vane. The links are connected up to the vane operating ring. The rings are operated by rods and levers from a vertical shaft which leads to the operating deck, where the governor is located.

The revolving balls of the governor control a pilot valve attached to an equalizing lever. This valve operates a relay valve, which in turn controls the main operating piston, which is connected to the vane operating shaft.

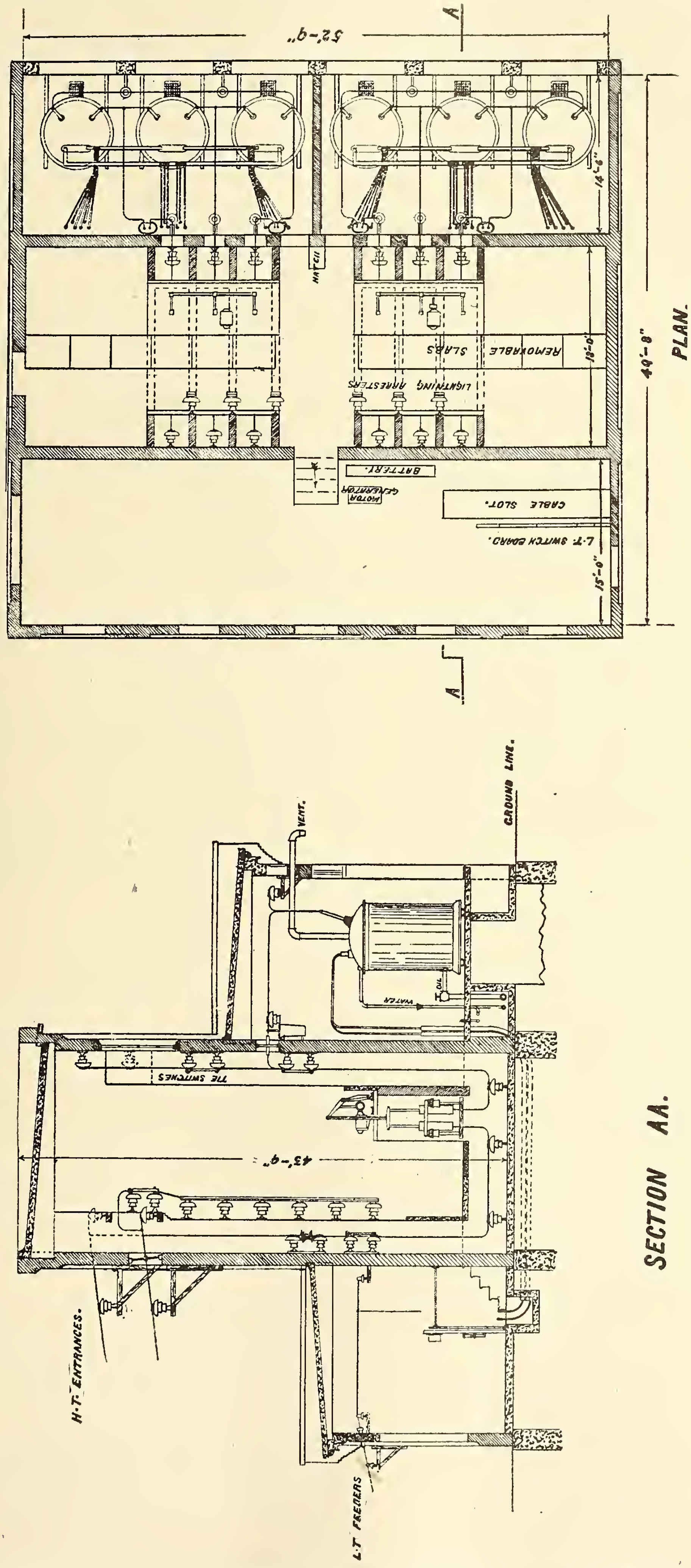
An oil pump, a pressure tank, and the necessary piping is furnished with each governor.

In order to control the speed of the turbines from the switchboard, each governor is furnished with remote electric control.

The two upper sections of the main turbine shafting are joined together by a cast steel coupling four feet in diameter. The brake mechanism is fitted about the coupling, the outer edges forming the brake band. Two brake shoes are applied on the brake band, and a hand mechanism is arranged so that a force of 10,000 pounds is brought on each brake shoe.

Each turbine is guaranteed to give an efficiency of at least 80 per cent. when delivering 8,000 horse-power, and operating under a head of 70 feet running at a speed of 180 revolutions per minute.

The hydraulic machinery is all the product of the I. P. Morris Company, whose hydraulic engineer,



POWER DEVELOPMENT FOR WEST KOOTENAY POWER & LIGHT COMPANY.
TYPICAL SUBSTATION.

Mr. W. M. White designed and carried out the work so successfully.

ELECTRICAL DEVELOPMENT.—The general scheme of electrical distribution is so arranged that power can at present be delivered to Phœnix, 79 miles distant, at 60,000 volts; Grand Forks, 69 miles distant, at 60,000 volts; Greenwood, 83 miles distant, at 60,000 volts, and to Rossland, 32 miles distant (in the latter case over the existing lines of the old plant), at 22,000 volts.

It will be seen that owing to the complication involved in tying-in to the old plant two transmission voltages were required, and therefore transformers, switching apparatus, etc., had to be provided for both.

The whole of the power so far sold is used for mining work for large motor equipments, for the lighting and power of the mines, and the lighting requirements of the various mining towns above mentioned.

In addition, it is thought that the company will be able, at some time in the not distant future, to sell power to the railways in the vicinity of Rossland for operating, especially on the heavy grades necessary in attaining the elevation of the Rossland camp. The haulage over those grades at the present time is operated by steam locomotives of special type. In some cases these are geared, and switchbacks are established along the route in order to ease grades and for safety. As the heaviest grade does not exceed 4½ per cent., this is quite within the capacity of a modern electric locomotive of considerably less total weight than the present steam machines, and as the advent of the single phase motor has rendered it possible to operate without the use of rotary converters or dynamo motor sets, the problem is much simplified.

GENERATORS AND EXCITERS.—The generators are four in number, each at 4,500 kw. capacity at 2,200 volts and 80 per cent. power factor, at a frequency of 60 cycles, being of the umbrella type and directly connected to vertical water wheels. Two units only are at present installed.

The exciters are two in number, each of a capacity sufficient to excite the entire equipment when finally installed. These are also of the umbrella type and directly connected to vertical wheels.

GENERATING STATION SWITCHBOARD.—As will be seen from plan No. 4, current is carried at 2,200 volts to the bus bars, in compartments elevated above the station floor, and formed entirely of concrete, all parts being thoroughly barriered with the same material. The top of this bus bar compartment, in which all operating transformers are placed, forms the base of a platform, upon which are mounted nineteen 2,200 volt oil switches, all being motor-operated by distant control from the bench board.

The bench board, which contains the controls for the whole of the station, including the 2,200 volt switches, 20,000 volt switches, 60,000 volt switches, together with the speeders for the water wheels, is situated in front of the instrument panel at the end of the station, all connections thereto being reduced to a pressure of not over 110 volts for safety.

The general switching arrangement has been worked out on the basis of two separate and distinct plants, which may be coupled together or run separately on any transmission line or any bank of transformers.

The cables for connecting to the low voltage bus bars, and from thence to the transformer station adjacent, are all rubber covered and drawn into bituminous fibre ducts, which are embedded in the concrete floors, partitions, etc.

TRANSFORMER STATION.—The transformer station is arranged for four banks of 60,000 volt transformers, each transformer being of 1,875 kilowatts capacity, at 60,000 volts, and one bank of three transformers, each of 1,000 kilowatt capacity, at 20,000 volts, for interconnecting between the station herein described and the old development, which is distant about one mile; of these, two banks of 60,000 volt and one bank of 20,000 volt transformers have been installed.

All of the switches throughout the transformer house are motor operated and controlled from the bench board in the same station.

In every case live parts, such as wires, etc., are kept three feet apart and eighteen inches from all walls and barriers, and mounted on 60,000 volt insulators. The transformers are oil-filled and water-cooled, and have all the necessary connections for natural circulation of water and for handling of oil into and out of storage tanks by means of oil pumps

SUB-STATIONS: PHOENIX, GRAND FORKS, GREENWOOD.—The design of these sub-stations, all of which are alike, is shown on the plan.

Both the transmission lines enter the tower through special entrances, consisting of plate glass and porcelain tubes; from whence the lines pass through the choke coils and disconnecting switches, and from there into the high tension distant control oil switches, and finally into the main transformers, being transformed in pressure from 50,000 to 2,200 or 440 volts, as required by the motor service.

The transformers of 1,000 kw. each are located in banks of three in separate compartments, the necessary cooling water and oil piping and tanks being supplied. The transformers are mounted on trucks and arranged so that they can readily be run out of the compartments.

HIGH TENSION SWITCH ROOM AND TOWER.—In this compartment are installed all the high tension apparatus, lightning arresters, switches, etc. The floor of this compartment is raised four feet above the general level, this space thus rendered available being used for carrying the high tension lines connecting between lines and switches. For convenience in inspecting and cleaning the lightning arresters, etc., an elevated walk way has been provided in this compartment. All low tension cables are carried in fibre conduit set in concrete.

LOW TENSION SWITCHBOARD ROOM.—This room contains all the control apparatus for the high tension switches, etc., as well as feeder panels for low tension lines, also the storage battery for operating the motor-operated switches, motor generator set for charging the batteries, etc. One end of this compartment is reserved as a store room for supplies.

The construction of this entire plant was done by day labor under the supervision of the engineers. It was commenced in June, 1905, and water was admitted to the forebay December 24th, 1906. Exciters were operated on December 29th, and one of the power units went into commission on the following day.

We desire to acknowledge the assistance of Mr. John L. Allison, member Canadian Society of Civil Engineers, and of Mr. J. N. Smith, for the able assistance given in designing this work, and also the services of Mr. Geo. E. Revell, A.M.C.S.C.E., Mr. Walter J. Francis, M.C.S.C.E., and Mr. A. C. D. Blanchard, A.M.C.S.C.E., who at various stages of the work directed its construction.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Will you please advise me through your columns how the carbons are arranged in the luminous arc lamps, how long a pair will burn, and about what they cost in reasonable size quantities?

Answer.—The carbon in this type of lamp come together at a fairly sharp angle, and both are controlled by the lamp mechanism. As you are no doubt aware, the electric arc is very sensitive to magnetic influence, and in this type of apparatus a small magnet placed between the tips of the carbons and slightly above them causes the arc to bulge out into the globe, thus doing away with shadows and producing a very long arc. The carbons which produce the golden yellow light will burn from ten to twelve hours, and, in lots of one hundred pairs, are sold for approximately seven and a half cents each, or fifteen cents a pair.

Question No. 2.—Is there any advantage in a steam separator in a steam pipe, other than removing the moisture from the steam?

Answer.—Steam separators are usually of two types, namely, plain separators, and what are known as receiver separators, the latter, as the name implies, acting both in the capacity of a separator and a storage chamber for the steam. When a separator, or received separator, is placed close to the throttle valve of an engine, it certainly has a good effect on the economy, as it enables the admission line, assuming the apparatus to be of proper size, to be carried out almost parallel to the atmospheric line to the point of cut-off. The type of engine, the distance from the boilers, the size of the steam pipe, and other factors, will of course affect the size of the separator to be used. To be effective as a receiver, it should not under any circumstances have a cubic capacity less than that of the high pressure cylinder if the engine is a compound one. and will give better results if it is three or four times this size. These remarks will apply particularly to Corliss engines.

Question No. 3.—I noticed in Toronto recently some electric process being used by the street railway at the corner of King and Yonge streets, with a machine which looked like a motor mounted on a wagon nearby. Can you give me some information with regard to this?

Answer.—The apparatus in question consisted of a 500 volt motor of about 30 horse-power capacity, which had mounted adjacent to its commutator a pair of collector rings. Current was obtained for the motor by connecting to the track and to the trolley wire, and it was used purely as a rotary converter, or, to use the generally accepted term, as an inverted rotary, meaning that direct current was transformed to alternating current. The voltage of the alternating current would be somewhere in the neighborhood of 400, and this was led to the primary coil of a special transformer hung by means of a chain block on a radial arm extending from the wagon. The secondary of the transformer consisted of a very few turns of heavy copper strips in multiple, and its terminals were so arranged that one rested on top of the rail in the groove, while the other made contact with the rail at a point slightly below the first and about the centre of the web. This heavy secondary carried a current of about 5,000 amperes, and was used entirely to heat the rail and bond wire, which latter was placed between the lower contacts and the web The use of the apparatus was purely to braze the bonding wire direct to the rail, the idea being that a more permanent contact would be made by this method than with the old idea of expanding the end of the bond in a hole drilled in the rail web. The transformer and apparatus, as explained above, was used purely for producing the heat necessary for the brazing process.

Question No. 4.—I am told some electric plants close down during a thunderstorm. What is the object of this if there is a lightning arrester on each line? Is it a peculiarity of the generator, or a fault or defect of the system, or for other reasons?

Answer.—No lightning arrester has as yet been placed upon the market which can be considered as absolutely reliable. There are many good makes which seem to act in a most satisfactory manner, but the fact remains that occaisonally they fail to remove the lightning discharge from the line and carry it to the ground, under which condition the discharge necessarily goes to the transformers or generators, and endeavors to jump to the ground through the insulation of such apparatus. In a small plant, where a shut-down is of no material inconvenience to the customers, it is sometimes the policy, in the event of a severe thunderstorm, to close down the plant and open all switches leading from the lines to the apparatus, leaving the lightning arresters connected as they always are between the line and the ground, so that they may take care of any charge which may come on the line. In a large plant, it is commercially impossible to shut down the equipment, as this would result in dissatisfaction of the customers, and a consequent loss of business. Hence, such equipments keep running and trust altogether to the efficiency of their lightning protective apparatus

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Mr. T. E. Essery is building a two-storey factory at 101 Ontario street, Toronto, for the manufacture of electric fixtures.

Munderloh & Company, Montreal, have moved into their new building at 51 Victoria Square. They have very complete offices, show-rooms and factory, and are in a position to handle their growing business even more satisfactorily than in the past.

''The graspin'est man ever knowed,'' said Uncle Jerry Peebles, ''was an old chap named Snoopins. Somebody told him once that when he breathed he took in oxygen and gave out carbon. He spent a whole day tryin' to find out which of them two gases cost the most if you have to buy 'em. He wanted to know whether he was makin' or losin' money when he breathed.''—Chicago Tribune.

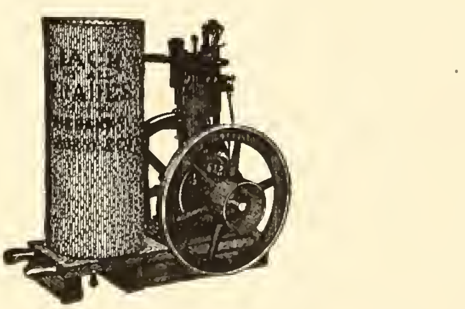
Internal Combustion Engines*

By R. A. Fraser.

(Continued from May issue.)

Regarding the use of alcohol as a means of generating power, there is a good deal of matter appearing in print relating to the use of alcohol in internal combustion engines, and many of the statements contaiued therein are somewhat misleading, particularly in regard to the economy with which alcohol can be used. The heating value of wood alcohol (specific gravity .8163) is 8,409 B.T.U. per pound. Of grain alcohol (specific gravity .814) 10,073 B.T.U. per pound, and of Cuban alcohol (specific gravity .824) 9,584 B.T.U.

Corresponding values for gasolene (specific gravity .71) is 18,296 B.T.U. per pound, and for kerosene (specific gravity .807) is 18,179 B.T.U. per pound. The Cuban alcohol referred to is manufactured from a cheap molasses which has hitherto been a waste product from the cane sugar mills in that country, and is sold, I understand, in Havana at the low price of 10 cents per gallon. It is then apparent that an engine, in order to run on as small a quantity of grain alcohol as of gasolene, would have to use the oil with nearly twice the efficiency. It is a fact that the gasolene or kerosene engine may be run on any of the alcohols above mentioned without much change, and the engine will give somewhat more power than on gasolene, but, on the other hand, the result will be disappointing because of the large quantity of alcohol consumed, this being, as might be expected from the heat values referred to, nearly twice the quantity that would be consumed with gasolene. It will also be found that the engines are harder



to start on alcohol, due to the greater difficulty in vaporizing, and it will be desirable to start the engine on gasolene, or to vaporize some of the alcohol, by previously heating it, in order to provide the necessary vapor for starting. It has been found that with alcohol much higher compression can be used in the engine without causing premature ignition, so that to get the best results from this fuel engines have to be built specially to suit it. Experiments have shown that the best results are attained when compressions of from ninety to one hundred pounds per square inch are used. The only objection, of course, to this high compression is the difficulty experienced in turning the engine over by hand, in order to start it. In an engine in all respects designed to operate on grain alcohol the consumption will be approximately fifty per cent. more alcohol by volume than gasolene.

Taking up the heat values of the different fuels in their order, they are about as follows:—Natural gas, 1,000 B.T.U. per pound; illuminating gas, 630 B.T.U.; producer gas, 125 to 150 B.T.U.; gasolene, 18,000 to 20,000 B.T.U. per pound; kerosene, the same; alcohol, 8,000 to 10,000 B.T.U. per pound.

It will be noted that gasolene has a lower heat value than natural gas, but will give more power from the same engine. This is due to the fact that the quantity of air necessary for complete combustion varies with the different fuels, and affects the horse-power developed.

Now, regarding the consumption of fuels: In the case of gasolene the accepted consumption claimed by all reputable engine manufacturers is one pint per B.H.P. per hour under full load.

The approximate consumption of kerosene is one-eighth of a gallon per B.H.P. per hour under full load, this quantity being somewhat exceeded in the smaller sizes, and slightly less in the larger sizes. In the case of illuminating gas, the accepted consumption is from 18 to 20 cubic feet per B.H.P. per hour under full load, and in the case of natural gas the consumption is from 12 to 13 cubic feet per B.H.P. per hour under full load.

With producer gas it is usual to guarantee a consumption of one and one-quarter pounds of pea anthracite coal per B.H.P. per hour when operating about the rated capacity of the engine.

Types of Engines.

At the present time, when the relative merits of the different types of motors are being widely discussed, it may be useful to properly classify them.

Broadly considered, internal combustion engines are hot air engines and divide naturally into two divisions—the "constant volume" and the "constant pressure" engine.

In the first, the heat is imparted to the air suddenly when the piston is practically at rest, and the air at constant volume being heated suddenly rises in temperature. As pointed out earlier in this paper, the resulting action is erroneously described as an explosion. All engines in which the air is compressed with the fuel, and fired when the piston is at rest on the dead centre, are "constant volume" engines.

These engines may be further divided into four and two cycle types, and these cover probably over ninety per cent. of the internal combustion engines in use to-day.

The "constant pressure" engine was described earlier in this paper under the head of fuels, its use being limited to the type using the heavy or crude oils as fuel. The constant volume four cycle and two cycle type are those in general use, and either may be worked at constant pressure or constant volume. The factors which go to make up a cycle are the same in the case of the four cycle and the two cycle. The great difference lies in the method of charging and exhausting. In the four cycle engine, one piston displaces the exhaust, draws in a fresh charge, compresses, and works. In the two cycle type, the exhaust is pushed out by the entering fresh charge, which comes in under pressure, the one side of the piston acting as a pump. The charge is then compressed and fired at a constant volume.

The two cycle engine, made in small sizes, using the crank case as a receiver and the piston as a pump, is the poorest attempt imaginable at a two cycle engine. The little two cycle engines so much in evidence, of course, have all the simplicity claimed for them, but they must not be taken as representative of the type. The chief draw-back to two cycle engines—even when carefully and correctly designed, and unfortunately that is not very often—is that there is not enough time at the exhausting and charging periods to perform these operations properly. The two cycle engine reduced to its scientific conclusion should only have the charge drawn into the cylinder after the exhaust has either been completely withdrawn or discharged, but, as pointed out, in the present types these operations frequently overlap, resulting in erratic operation and excessive consumption of fuel.

Mechanical Construction.

In taking up briefly the last head, namely, the mechanical construction of the engine, it may be pointed out that up to a certain point the gasolene engine closely resembles the steam engine, in so far that the energy is transmitted to the shaft through a piston operating in a cylinder. There, however, the resemblance ceases, as what would pass muster in steam practice would be fatal in a gas engine. In one respect the gas engine may be said to resemble a quick-firing gun, in so far that the initial pressure and temperature is very high. In all well-designed engines, the tendency is to keep the compression as low as possible, consistent with economy. The maximum pressure at ignition should not exceed three hundred pounds, equivalent to about twenty-seven hundred degrees Far. Many

engines on the market carry pressures of four hundred pounds and over, and just what this means is best illustrated by an example. Taking a cylinder four inches in diameter, at three hundred pounds, the total pressure, at the moment of ignition, is about thirty-seven hundred and fifty pounds. Now, if the ignition pressure be increased to four hundred pounds, the ignition pressure amounts to five thousand pounds, representing an increase of over 30 per cent., all tending to increase the wear and tear on the engine. In a general way, it may be stated that within limits the higher the initial pressure the greater the horse-power developed. This is a point that is very misleading to the layman in making comparisons as to the horse-power developed by engines of different makes, whereas a moment's reflection will convince one that the rating of an engine may be materially raised by using high compression and correspondingly high temperature, but it must also be evident that such an engine is much less likely to prove satisfactory and serviceable than an engine with low compression and low temperture. I have just remarked that what would pass muster in steam practice would fail completely in a gas engine. You will appreciate the fact that the cylinder of a gas engine, in order to stand the high pressures and resist the high temperatures which fluctuate within a wide range, call for a special grade of close-grained iron; not only so, but, as the efficiency of the engine absolutely depends on the compression being maintained, you will see that it calls for the accurate machining and fitting of both the cylinder, piston and rings. Coupled with this, the cylinder has to be water-jacketed, causing the cylinder castings to be expensive to mould, and, as frequently happens, a cylinder may be all machined and the engine on the test floor before any defect is found, perhaps simply a small leak between the water-jacket and the cylinder, due to spongy metal, or some other cause, the result being that the cylinder has to be thrown away, and a new one substituted. These experiences are almost unknown in steam practice, and answer in part the question so often asked as to why a gas engine is so much more expensive than a steam engine of the same horse-power.

Valves.

The valves in an internal combustion engine naturally are important, and come in for a good deal of consideration. These consist simply of an inlet and exhaust valve, and the accepted practice is to make these of the "poppet" type, either making them from drop-forgings, or, preferably, of nickel steel.

The invariable practice is to operate the exhaust valve mechanically. The inlet valve may be either mechanically operated or of the automatic type, opening by the vacuum created in the cylinder as the piston descends. There has been, and there is still, a good deal of controversy as to the merits of the mechanically operated and the automatic admission valve. It may be said at once that both types have merits; the automatic type certainly has the merit of great simplicity, requiring no mechanism of any kind to operate it, and this type has been consistently used by some of the best known and largest engine manufacturers with uniform success. Incidentally, one of the largest European manufacturers, realizing that both types have merits of their own, have devised a compromise in an effort to utilize the advantages of each type, and the results are said to be eminently satisfactory.

Vaporizer.

The systems by which the liquid fuels are led to the engine are two—known as the "gravity feed" system, where the fuel tank is located above the engine, and flows to the vaporizing device by gravity; the other is the "pump feed" system, where the fuel tank is placed below the level of the engine, and may be located at some distance away, the liquid being pumped to the vaporizer by a small pump run by the engine, the surplus returning to the tank by gravity. The gravity feed system, for stationary service particularly, has been discarded by all reputable makers, and rightly so, since, as a matter of fact, practically the only merit in the system was its cheapness.

The devices for converting the liquid fuel into gas are legion, and are known as "vaporizers," carburetors," etc. For stationary work, the vaporizer is in general use, as it is remarkably simple, and devoid of mechanism of any kind. For automobile and marine service, the accepted type is that known as the "float-feed carburetor." The principle of operation is essentially simple, but the latest types have become more or less complicated, due to an effort to devise a carburetor adapted for a variable speed motor which will respond instantly and maintain a constant mixture under wide ranges of speed and load.

Governors.

The systems of governing in general use are practically two, known as the "throttling" and the "hit and miss" systems. In the throttling system, the governor automatically regulates the amount of mixture admitted to the cylinder, that is, the more the load the more the mixture, the less the load the less the mixture. In the "hit and miss" system, the governor automatically controls the number of explosions, or impulses, each impulse being of the same intensity, that is, the more the load the more the number of impulses, the less the load the less the number of impulses. The throttling system is used on all engines for electric lighting service, as with this system very close regulation can be attained—as a matter of fact, within two per cent. at full load. The system, however, is not economical on light loads. On the other hand, the "hit and miss" governor,' while not giving such close regulation, is preferable, owing to its higher efficiency on light loads, and is the system in general use for all other purposes, except those where very close regulation is called for. In the case of the throttling governor, the method of operation is comparatively simple, consisting of either a slide valve or a throttle valve placed between the vaporizer and the cylinder, and controlled by the governor. In the case of the "hit and miss" system, the methods and devices are legion. Some govern the fuel supply; some cut off the electric current; and in some types, particularly horizontal, all operations are stopped by the governor controlling the second motion shaft. Probably the simplest and most efficient method is that whereby the governor simply holds the exhaust valve open, with the result that there is no vacuum created to open the inlet valve, and no compression to add to the load on the engine, so that, under light load, the engine runs freely and with the minimum amount of friction.

Ignition.

The question of ignition is the last factor which we may take up for consideration, and yet, perhaps, of all the functions in the internal combustion engine, the one of most importance—viewed from the point of getting satisfactory results in operation—and it may be well to state here that the question of ignition is at the root of fully ninety per cent. of so-called gas engine troubles. Time will not permit my reviewing the earlier systems such as "flame ignition," "hot tube" ignition, "wipe spark," etc., etc.

At the present time, there are but two systems in general use, namely, what are known as the "make and break" and the "jump spark" systems, and but two means of furnishing the electric current, either chemically, by means of batteries, or mechanically, by means of a dynamo, or magneto.

In the case of the "make and break" system, an electric circuit from a battery, or other source of electric energy, is closed by means of the contact points within the compression spade, the current passing through an inductive resistance, in the form of a spark coil, on its way from the source of energy. Upon breaking the circuit, the inertia produced by the induction raises the pressure of the circuit, and causes a hot spark to jump across the terminals. You will note that two conditions are necessary in order to obtain a spark sufficiently hot and strong to ignite the charge, that is, a comparatively strong electric current has to be available, and the mechanism of the igniter must be in good order, so as to produce a sharp break at the points. In other words, the current may be strong, but the igniter sluggish in operation, which would be fatal to obtaining a good spark, so that, in the case of having trouble with an engine, it is always wise, in addition to making sure that the electric current is sufficiently strong, to examine the igniter, so as to make sure that the springs have not become weakened, and it will often be found that by increasing the tension on the igniter springs the intensity of the spark can be increased, and the efficiency of the ignition mechanism materially improved.

In summing up the strong points which go far towards efficiency in mechanical construction, these are simplicity, durability, first-class material and workmanship.

Regarding simplicity, a man does not need to be an expert

to appreciate the fact that the fewer number of working parts an engine, or in fact any machine, has, and still works well, the better, as the less there is to renew and the less renewals will cost.

In the matter of durability, weight and speed are the two factors which make for durability. An engine must have weight, which also means strength to resist the stresses due to pressure and temperature, also an engine must run at a moderate speed to live long. If two engines pulling the same horse-power are set side by side, the heavier built and slower speed machine will certainly outlive the higher speed light machine.

There only remains the question of workmanship and material, and these must necessarily be of the best. The only point to emphasize is the necessity of every portion being accurately machined, and the desirability of having all parts absolutely interchangeable.

CONCLUSION.

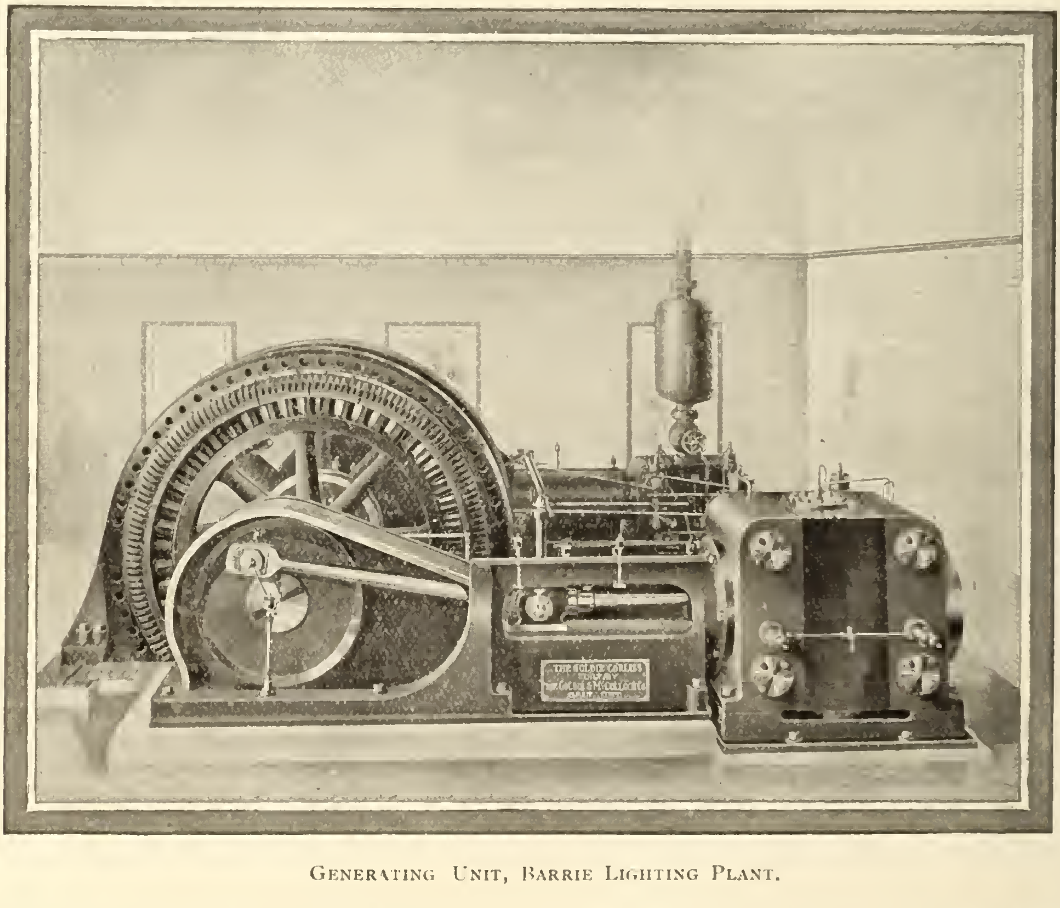
In concluding, I may just remark that no one man or firm can combine and retain all the points necessary to produce a perfect machine. All engineering, like everything else, is more or less in the nature of a compromise, and the best we can all do is to endeavor to increase our efficiency from the standpoint we have reached by careful study and well-directed effort.

THE BARRIE MUNICIPAL LIGHTING PLANT.

The first electrical installation was made in Barrie some sixteen years ago by a private company, the equipment comprising one 16 foot x 66 inch horizontal return tubular boiler, and a 14 and 28 x 36 Brown engine. A 133 cycle, single phase, 2,200 volt alternator of approximately 50 kilowatts capacity was installed, together with an equipment of direct current series arc machines. In 1899 the plant passed into the hands of the municipality, and was completely remodelled. The old boiler and engine rooms were made into one, and a 12 and 22 x 30 Wheelock engine was installed. Two new boilers, 16 feet x 73 inches, each containing 96 3 1-2 inch tubes, were purchased from the Goldie & McCulloch Company. A new smoke stack was built, and a 150 kilowatt, 66 cycle, S.K.C. generator of the two-phase type, wound for 2,200 volts, was installed. The arc machine equipment was enlarged, and new switchboards purchased for the two generators. The load on the plant steadily increased, until in 1903 it was found necessary to install meters.

Considerable controversy arose as to the frequency of the meters to be used, but this was finally decided at sixty cycles, and, as matters stand at present, every consumer using three lights or over is purchasing current on the meter basis. This made a material reduction in the load on the plant, but three years later it was found necessary to increase the capacity. This question was very carefully worked out, and we understand that the town has to-day one of the most economical equipments to be found in the Province of Ontario.

The old boiler house was considerably enlarged, and a new Backcock & Wilcox boiler was installed therein. This new boiler contains some 2,000 square feet of heating surface, and is designed for a working pressure of 165 pounds to the square inch. A cross compound, high speed Corliss engine with steam actuated dash pots was purchased from the Goldie & McCulloch Company, and a 350 kilowatt, two phase, sixty cycle, 2,300 volt, 150 revolutions per minute, Bulloch generator was mounted directly upon its shaft. This generator, which is shown in the illustration, was supplied by Allis-Chalmers-Bullock, Limited, Montreal.



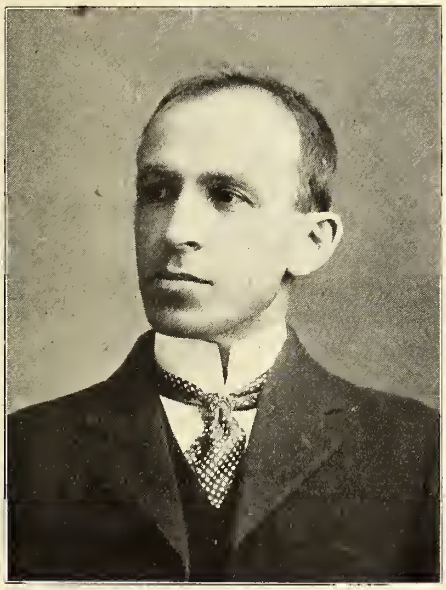
GENERATING UNIT, BARRIE LIGHTING PLANT.

The Goldie & McCulloch engine is designed to run in parallel with a second machine of this type which it is proposed to install in the present power house. The high pressure cylinder is 14 inch diameter x 30 inch stroke, and the low pressure cylinder 28 inch diameter x 30 inch stroke. The engine runs at a speed of 150 revolutions per minute. The flywheel is 12 feet in diameter and weighs 16,000 pounds. This

engine is of the latest design and has heavy duty frame. The valve gear is of the Corliss trip type, fitted with steam actuated dash pots, which enable a quick cut-off to be obtained even with the high rotative speed at which the engine is running.

There is also mounted on the shaft of the engine a double-flanged pulley 42 inches in diameter, which is used for driving a 17 kilowatt exciter, furnished also by Allis-Chalmers-Bullock. This pulley is mounted between the generator and the flywheel, and hence is not unsightly.

A 12 and 18 x 18 independent jet condenser was also purchased from the Goldie & McCulloch Company, and a heater of the open type was installed by the Canada Foundry Company. Two duplex, outside packed plunger pumps were supplied by the Deane Steam Pump Company, of Holyoke, Mass., and these, with the old duplex pump formerly used in the plant, comprise the feed water supply. One pump, operating under a Williams governor, supplies water from the hot well to the heater, while one of the other pumps takes its water from the heater and delivers same to the boiler, the third pump being held as a spare. The pump connections are so arranged that any of the three machines may be used either



EDWARD B. MERRILL,
B. A., B. A. Sc., A. M. Can. Soc. C. E., Associate A. I. E. E.
Who is now Chief Assistant Engineer of the new Hydro-Electric Development at Pointe du Bois for the City of Winnipeg.

for supplying the heater or delivering to the boiler, and hence the equipment is extremely flexible.

The heater discharge is equipped with a thermometer, and a similar device has been placed on the outlet of the condenser, so that the highest possible temperatures may be continuously maintained. The steam delivered to the heater is the exhaust from the feed pumps and condenser, and is just sufficient at full load to give a feed temperature a little over 200 degrees Fahrenheit.

All low pressure piping was supplied by the Garth Company, of Montreal, while the high pressure lines, which consist of extra heavy pipe, flanges, and fittings, put together with copper gaskets, were supplied by the Walworth Company, of Boston, Mass. A new 50 light constant current transformer, with full complement of lamps and absolute cutouts, was furnished by the Canadian Westinghouse Company, Hamilton, Ont., who also supplied the arc and generator switchboards.

Pending the installation of a second direct connected unit, the old boilers, the Brown engine, and the S.K.C. generator are being retained, but when the time comes for the change, this belted equipment will be discarded, and a new engine designed for working on 150 pounds initial pressure will be installed.

As the plant stood before the present changes were commenced, the engine room was completely filled, and hence, to put in the new unit, the Wheelock engine had to be taken out. The new installation has been made throughout with the idea in mind that future enlargements will not in any way whatsoever disturb the existing equipment, and this will be appreciated as a very desirable condition of affairs, and directly opposite to that which existed a year or so ago.

The new engine and generator were put into commission on December 12th, 1906, and the official tests were made in March of the present year. When operating at its most economical point, the engine developed an indicated horse-power on approximately 13 1-2 pounds of steam per hour. This is with a boiler pressure of 160 pounds and a 27 inch vacuum in the condenser. This remarkably high vacuum for a condenser of this type is made possible through the general arrangement of the exhaust piping, and it is being maintained continuously.

Mr. K. L. Aitken, consulting engineer, of Toronto, had charge of the recent remodelling and enlarging of the Barrie equipment.

OLD TIME TELEGRAPHERS' ASSOCIATION.

The Old Time Telegraphers' & Historical Association will hold its next reunion at Niagara Falls, N.Y., on Monday, Tuesday and Wednesday, September 16th, 17th and 18th.

MARK TWAIN ON ADVERTISING.

In addressing a banquet, given by advertising men, Mark Twain, using for his text, "It Pays to Advertise," told the following story:

"When I was editing the 'Virginia City Enterprise,' writing copy one day and mining the next, I tried to drive this truth home in many ways. One day I received a letter from a subscriber, saying he had found a spider pressed between the pages of his paper. He wanted to know whether this signified good or bad luck. I replied to him in our Answer to Correspondents' columns as follows:

"Old Subscriber—The finding of a spider in your copy of the 'Enterprise' was neither good luck or bad. The spider was merely looking over our pages to find out what merchant was not advertising in them, so that it could spin its web across his door and lead a free and undisturbed existence forever after."

Motto—Beware of spiders and advertise in THE CANADIAN

The Concrete Pole Company, Limited, of St. Catharines, Ont., have been awarded the contract for the supply and erection of 100 concrete poles in the city of Windsor for the Windsor, Essex & Lake Shore Railway.

Mr. Fullerton, who has been appointed as counsel for the Ontario-Niagara Power Union, has recommended the appointment of an electrical expert to assist him in making contracts between the municipalities and the Hydro-Electric Commission.

The Shelburne Electric Company, of Shelburne, N.S., have let the contract for the electrical equipment of their plant to the Canadian General Electric Company. The plant is situated on the Roseway River, one mile north of Shelburne, and will furnish power for lighting and for manufacturing purposes. C. L. Hervey, C.E., was the designing engineer.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 1st day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired without cost to the advertiser, hut to insure proper compliance with the instructions ofthe advertiser, requests for cbange sbould reacb tbe office as early as tbe 26th day the month for the succeediug month's issue.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of Subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payahle in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, hut where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give tbe old as well as tbe new address.

Subscribers are requested to promptly notify tbe puhlisbers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately witbin the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Moore Tube. With two notable exceptions, namely, the Mercury Vapor lamp and the Moore tube, our commercial sources of light depend upon the heating to incandescence of various solids, of which carbon is really the best known and the most used. As mentioned in previous issues the recent changes in incandescent lamp manufacture have been due to the discovery and utilization of other solids than carbon for filaments, and, while the saving effected thereby has been material, we must not lose sight of the possibilities of lamps in which the solid conductor is replaced by a gaseous one. Mr. Peter Cooper Hewitt and Mr. D. McFarlan Moore are two gentlemen whose names are well known in connection with gaseous lamps, the first having to his credit the mercury vapor light, and the second the apparatus which is best known as the Moore tube. When it is borne in mind that light and heat are one and the same thing, differing only as regards to wave length, it is apparent that any apparatus which will produce the former in large quantities with a correspondingly small complement of the latter, will have a relatively high efficiency. It is this fact which has led to the development of the gaseous lamp. We are all more or less familiar with the Mercury Vapor apparatus, and, while it must be acknowledged that the efficiency is high, still there are two elements which work against the general adoption of the lamp for commercial purposes, namely, its high intrinsic brilliancy and its color. For certain industrial processes, it is argued that the color of the Mercury Vapor lamp is well suited, and attempts at factory illumination have at several points met with unquestioned success. That the character of the light is unsuitable for general illumination has been shown by the various attempts to correct its color, and apparently this cannot be done except through the medium of apparatus external to the lamp itself. Successful illumination can only be obtained in one manner, namely, the light must be as near daylight as possible, and its intrinsic brilliancy must be of such a nature as to produce no unpleasant effect upon the eyes.

We do not know of any Moore tubes in use at the present time in Canada, their field being limited almost exclusively to the immediate neighborhood of Newark, N.J., the home of the inventor, though of recent years quite a large number have been installed in departmental stores in New York City. Mr. Moore has attempted, as far as possible, to make his light an ideal illuminant, namely, one which has a spectrum similar to daylight, and one in which the light source is well distributed. There is one marked advantage for the Moore tube, in that the color of the light can be changed, not at will of course, but merely by utilizing a different gas. The lamp consists of a glass

tube, varying in size from one to two inches in diameter, and of a length between fifty and two hundred feet. These tubes are made up on the ground, and are installed in various shapes, often being made to conform to wall angles, offsets, pillars, etc., such as found in the lower floors of buildings used for commercial purposes. The tube is always arranged in a complete circuit, that is to say, it ends close to its starting point, and the two terminals of the tube, each of which contains a carbon electrode, are brought into a sealed box containing two very simple pieces of apparatus, namely, a transformer and a regulating valve. The primary of the transformer is wound for connection to any standard voltage alternating current main, and it has in series with it the coil of the regulating valve, which will be described later. The secondary of the transformer is connected directly to the carbon electrodes in the tubes, and the transformer ratio is such as to give a terminal voltage of approximately seven thousand for a one hundred foot tube, and twelve thousand for a two hundred foot tube. The regulating valve is probably the most ingenious part of the entire system, and for many years, before it was perfected, it proved to be the serious drawback of this system of lighting. It is well known that a vacuum tube, which, due to the passage of an electric current, is made luminous, will, in a very short period of time, alter its vacuum and as there is of course a condition of vacuum in the Moore tube at which a maximum efficiency is obtained, it is desirable to incorporate an apparatus which will automatically maintain such vacuum. The control is purely electrical, and is made possible due to the fact that a change in vacuum means a change in resistance, and hence in the quantity of current which any tube may take. The regulating tube is about three-eighths of an inch in diameter, and is attached to an end of the large tube near one of the electrodes. The end of the regulating tube is closed by a plug of carbon which is in a cupped shape vessel, and is normally covered with mercury. This carbon plug has sufficient porosity to admit the passage of small quantities of air or other gases, but will not allow the filtration of the mercury. The mercury, therefore, acts as a seal, and prevents any air passing into the tube. A very light magnetic core is made up of a smaller glass tube, in the end of which are some fine iron wires. This glass tube fits loosely around the tip of the carbon plug, and when in its lower position raises the level of the mercury slightly above the level of the tip. The core is acted upon by a solenoid, which is in series with the primary of the transformer. When a change of vacuum occurs in the tube, such as to decrease its resistance, the current in the primary of the transformer naturally increases, and hence the lifting power of the solenoid is strengthened. A slight upward movement on the part of the core exposes the tip of the carbon plug, and air or other gas immediately enters the tip in almost infinitesimal quantities. When the vacuum reaches its proper degree again, the core sinks to its normal position, and hence the infiltration of air ceases. This control valve may be said to be practically frictionless, and really is quite perfect in its operation. Under normal usage, the valve feeds about once per minute during the entire life of the tube, which, it may be pointed out, is practically infinite. If a tube is allowed to feed itself on plain air, the light emitted is of a delicate pink hue. The use of nitrogen produces a golden yellow light, whereas carbon dioxide results in an almost perfect white. This white, it must be admitted, appears to the eye to contain an element of blue, but, so far as the matching of colors is concerned, no difficulty has been experienced from this source and we feel safe in saying that there is less of the blue ray in the Moore tube than in the enclosed arc. The highest temperature reached by the tubes is also another factor in favor of the system, one hundred degrees Fahrenheit being the maximum. So far as efficiency is concerned, as in the case of the luminous arc, the golden yellow light is by far the most economical. To our mind, the beauty of the whole system, leaving entirely out of consideration the engineering features of efficiency and kindred matters, is the well-destributed illumination which makes it possible to gaze directly at the tube without the retina being strained. The idea of the long tube also has the desirable effect of eliminating shadows, and it certainly produces a very soft, but highly satisfactory, light.

Mr. Moore, in developing this system of lighting, endeavored to get away from what he terms the "intense point" idea, and he has certainly succeeded in producing a decidedly acceptable substitute. The following table, based on the quantity of light radiated per square inch of surface, gives a very good idea of the various types of lamps now being used:

Moore tube	From .33 to 2.
Mercury vapor lamp	19.
Incandescent	250.
Nernst	600.
Arc	10,000.

The efficiency figures presented by Mr Moore are certainly remarkable, and the general nature of his light is such as to make a comparison difficult. In one case, where the light given by the tube was pink, he states that the system had an efficiency 5.1 times that of a similar incandescent lamp equipment, whereas, with the golden yellow tube, another equipment showed an efficiency 2.9 times that of an enclosed arc system. With the use of carbon dioxide, the efficiency is stated to be one and a half times that of enclosed arcs. The Moore tube is the result of many years of persistent effort, and the inventor is certainly to be congratulated upon his success. His figures as to efficiency have been much criticized though we feel safe in saying that if the tube system has an efficiency even equal to enclosed arcs, its use will become general in the near future. The operating cost, other than current consumption, is practically negligible, and unless the tube is damaged through external violence its life appears to be infinite.

SPARKS.

Port Arthur has applied for the right to develop water power at Dog Lake Falls, on the Kaministiquia River, to the extent of 3,000 horse-power.

The third unit in the Electrical Development Company's power house at Niagara Falls was started about three weeks ago, and a fourth unit is ready to be tested.

An announcement was made some time ago of a proposed plan to generate electric power from the lake on the mountain at Glenora, in Prince Edward county. The scheme is now said to have fallen through on account of the difficulty of securing sufficient capital.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

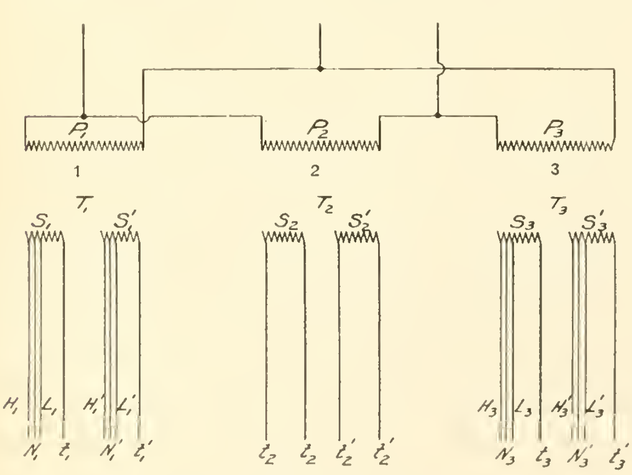
Arrangements for the annual convention of the Canadian Electrical Association, to be held in Montreal September 11th, 12th and 13th, are progressing satisfactorily, and a programme full of interest is already assured. Eight papers have been promised, and the committee have others in view. Negotiations are now under way with the railways to secure the lowest possible rate, and it is probable that a definite announcement on this point will be made in the next number of THE ELECTRICAL NEWS.

The Electrical Exhibition, which will open in Montreal September 2nd, has aroused considerable interest and promises to attract a large number of exhibitors and visitors. Mr. R. S. Kelsch has been appointed managing director, and is giving the Exhition his personal attention. It is expected that apparatus for exhibit will be admitted free of duty, provided it is returned within sixty days

Any electrical man who visits Montreal during the first two weeks of September will be well repaid.

DOUBLE SECONDARY WINDINGS.

A special and novel feature of the transformer equipment of the Manchester & Nashua Street Railway, in Southern New Hampshire, is the provision of a double set of secondary windings in each transformer, with special taps in the windings of two of the transformers to enable the rotaries to be operated on high, normal or low voltage, e. g., with 11,000 volts primary, 396 376 or 360 volts. The alternating current sides of the rotaries in this sub-station are not operated in multiple, though the transformer primaries are permanently connected in delta, there being but one set of these. One secondary winding in each

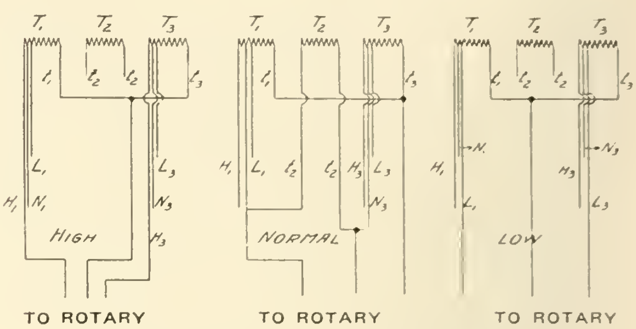


TRANSFORMER CONNECTIONS FOR SINGLE PRIMARY AND DOUBLE SECONDARY WINDINGS.

transformer is devoted to the exclusive use of a corresponding rotary. The direct current sides of the rotaries are operated in multiple, as usual.

An accompanying sketch shows the general transformer arrangement, with the single primary winding and double secondaries of each transformer. P1, P2 and P 3 are the primaries of transformers 1, 2 and 3; S1, S2 and S3 are secondary windings of the three transformers devoted to one rotary R; and S1′, S2′ and S3′ are the windings connected with the other rotary R′. The taps H1, N1, L1, t1 t2t2 and H3, N3, L3, t3 give the high, normal and low voltage combinations for rotary R, while the corresponding taps of the other windings do the same for rotary R.

Another sketch shows the secondary connections to impress high, normal or low voltage upon the terminals of rotary R. T1, T2 and T3 are the secondaries of the three transformers and the taps are shown as in the other figure. On the high and low positives the second transformer is not needed. When rotary R1 is shut down the corresponding secondary wind-



SECONDARY CONNECTIONS FOR HIGH, NORMAL AND LOW VOLTAGES.

ings are idle. The connections shown in the diagram are made easily on the switchboard by manipulating the double-pole, double-throw switches for each rotary.

WIRING RULES IN GREAT BRITAIN.

The Institution of Electrical Engineers has issued a revised edition of its wiring rules. These have been completely revised and constitute the fifth edition, the fourth edition having been published in 1903. Since then representations were made to the Council of the Institution that the next edition should be thoroughly of the Institution, the fire insurance offices the Muncipal Electrical Association and the Electrical Contractors' Association. This committee is further assisted by the Engineering Standards Committee and the Cable Makers' Association.

The chief alterations in the rules concern flexibles. Pure Para rubber or vulcanized rubber is specified as the insulation, and pure rubber flexible must be tested for fifteen minutes with a pressure of 1,500 volts alternating between the conductors at a frequency of fifty periods. Vulcanized rubber flexible has to undergo the same test after twenty-four hours' representative, and consequently a standing committee has been appointed which consists of members immersion in water. Although not expressly stated in the rules, the committee is strongly in favor of pure rubber flexible for all purposes, but it only recommends it for use with pendants. All conduit must be electrically and mechanically continuous and connected to earth.

The new standard of the Engineering Standards Committee has been adopted for pure copper, superseding Matthiessen's standard.

Cable tests are now specified to withstand 2,000 volts, either between conductors or between conductor and water, for half an hour.

There are a number of other alterations.

The question of flexibles is just now receiving much attention in England. Professor Schwartz of the Manchester University has read a paper before the Institution, in which he, too, recommends the use of pure rubber flexible for all purposes His specimens showing the great state of preservation of such flexible after many years' use compared with vulcanized flexible were very striking.

INSTALLING RIGID CONDUIT.

To prevent any possible chance of death or fire, in installing rigid conduit, it should be run as nearly straight as possible and supported every five (5) feet with clips; using hack-saw to cut the pipe instead of pipe cutters. Carefully reaming the ends of the conduit, and, where enamel has been removed, paint the same to prevent rust; using boxes at all outlets, not to be smaller than 3 inches in diameter and 3 inches deep, using lock nuts and bushing on conduit where entering boxes. Box to be free from holes and set flush with surface. If gas pipe is brought into box, a combination box should be used with a thimble to go over the gas pipe. Cut-out cabinet to be located within reaching distance of the floor, with a spring to keep the door closed. Cabinet to be lined with slate, and gutters to carry the wires around opposite their cut-out where they are going to enter, using slate gutters—or if iron to be bushed with porcelain tubes so that wires of opposite polarity will pass through separate holes, bonding the conduits together with copper wire. Where they cross gas or water pipes remove the enamel from the conduit, wrap them together with copper wire, paint same to prevent rust, putting a wire jumper on the gas meter; and the ground used on the conduit system in general to be brought back of water meter or gas meter. Where the rubber has been removed from the wire to make connection, place at least two (2) windings of rubber tape over bare wire, then wrap with at least two (2) coats of friction tape, going back as far as braid has been removed from the wire—using care that no sharp burrs or points shall come through the tape. Where heavy wires are used in conduit for risers place a box on each floor, so that the wire can be fastened, and not allow all the weight to come on the wire on the top floor. No conduit piping to be run within one (1) inch of a steam pipe, nor boxes to be installed that are not readily accessible; nor wires to be fished in conduit until the building is plastered.

In machine shops where belts, shafts, and oil are in general use, run the pipes along over the work bench on the side wall, placing an outlet box or condulet opposite each vice, using the one-half inch flexible steel conduit with three-eighth socket and No. 16 3-/32 rubber covered wires supplying current to each lamp, running in the conduit the regular standard double braid wire. For drop lights over lathes use the flexible steel conduit. This class of work protects all the wires from mechanical injury, and at the same time makes the lamp flexible so it can be changed to any position desired by the workman; protects it from all oils and does away with all repairs.

The reasons for grounding conduit are as follows:

All the electric light companies ground their neutral or negative wires, all metallic piping in building and metal ceilings which come in contact with said pipes would be charged with negative current, and unless conduits were rigidly grounded, and should come in contact with said pipes, or metal ceilings—it would cause a leak of electricity between the two which would mean a loss of current and which could not continue for any length of time without causing fire.

Where conduit is not grounded you get a static discharge from the conduit if you come in contact with it while standing on the ground, which is very disagreeable.

MONTREAL

Branch Office of The Canadian Electrical News,
Room B34 Board of Trade Building.

June 8th, 1907.

Several months ago the City Council requested the Montreal Light, Heat & Power Company to reduce their price for gas by about 25 per cent and for electric light by 33 1-3 per cent., offering, in the event of the company's acceptance, an extension of their franchise for twenty years. The company have recently replied, declining the offer, although it is just possible that the late action of the Quebec Legislature may have had some bearing on the company's refusal. The action of the Legislature as referred to was to the effect that any franchise given by the corporation extending over ten years must first be approved by a majority vote of the citizens.

Unless the weather makes a decided change the fan motor business will not be up to the usual mark in Montreal this season.

Mr. J. W. Brooks and Mr. Salisbury, of the Pass & Seymour Company, were recent visitors to Montreal.

Messrs. J. A. Dawson & Company have at last finished their ardnous task of rescuing goods from under the debris where their back wall fell in during their recent fire.

The trade in general complain bitterly about slow deliveries of goods, owing to the congestion of freight at both railway depots in this city; the express companies in consequence are reaping increased business.

The City of Montreal are contemplating burning garbage with an incinerator, such as has been adopted by the Town of Westmount, so as to produce power therefrom—this power to be used in lighting their works, although some of the Council seem to have a hazy idea that there will be enough power from this source to illuminate all the streets of Montreal. Apart from this latter dream, there is no reason why they should not attempt to do something with the garbage in a small way, as their present incinerator is no better than a bonfire, in fact less efficient.

As warm weather is now upon us, the old question of the Street Railway Company being requested to tender for snow removal will probably not come on the table for consideration of the Montreal City Council until (as in former years) it is too late to do anything, and next winter will see the same array of box sleighs instead of modern electric appliances.

Prince Fushimi, of Japan, will be the guest of Sir H. Montagu Allan while in Montreal. The spacious grounds and architecture of the building, "Ravenscrag," will be illuminated, as well as considerable special electrical detail for interior convenience.

The Cranbrook Electric Light Company, Limited, which for the past few years has been doing an electric light and telephone business in Cranbrook, B.C., and vicinity, under provincial charter, applied on May 10th to the ratepayers of that city for a by-law granting them the privilege to extend their pole routes to all parts of the city, their rights under provincial charter to do so having ceased when Cranbrook became an incorporated city eighteen months ago. The by-law was carried by a vote of 165 to 11. It is the company's intention in the near future to erect a power plant on the St. Mary's River, about seven miles north of Cranbrook. At the first they will put in a 700 kw. generator, 6,600 volts, with step-down transformers at Cranbrook, reducing it to 2,250 volts, which will suit the present transformer equipment. A single unit, to operate the generator, will be installed, and provision will be made to put in another unit and generator of similar capacity when the demand warrants it. A dam will be constructed on the St. Mary's River, which will give a maximum of 2,200 horse-power. The estimated cost of the plant is between sixty and seventy thousand dollars. During the past year the long distance telephone lines of the company have been extended to the Elkmouth district, 70 miles east of Cranbrook, to Yahk, 45 miles west of Cranbrook, and to Wasa, 25 miles north. They are about to build to Elko, where they hope to make connection with the Crow's Nest Pass Electric Company's lines, thus giving Cranbrook direct telephone communication with Fernie. They are also installing a telephone exchange at Moyie, B.C.

HOW TO INSULATE ARMATURE COILS.*

Armature coils are made in so many different varieties that several different methods of varnishing are necessary in order to secure the best results with each different kind. For the insulation of direct current motor and dynamo armature coils, it is advisable to use what is known as the "double-dipping" method, as all coils of this kind are usually form-wound and are, therefore, readily adapted for this treatment.

The treatment is as follows:

After the coils are formed, they are clipped together at the corners, and dipped right into the varnish compound, and then allowed to dry. When the coils are thoroughly dry, they should then be taped and again dipped in the varnish compound—and dried. To get the best results on this class of work, particularly when handled in quantities, the varnish must have great plasticity, and good insulating and quick-drying properties.

The varnish should also be a combined baking and air-drying varnish, as quick-drying varnish is often an absolutely necessary factor—in many cases, the varnish must be thoroughly dry from one to two hours after baking.

The varnish which has great plasticity is also of vital importance on this class of work, because in making up the standard types of machines, it is often desirable and economical to make up at one time enough coils to provide for the entire output of each size machine for a long while ahead—in many cases for six months or even a whole year.

Great plasticity is, in this way, of great value to the coil manufacturer, as it enables him to make up a big lot of coils and stock them, without any fear that the coils will harden, or that the insulation will break when the coils are finally assembled in an armature later on, as so often happens when a hard-drying varnish is used on the coils.

On armature coils of street railway motors, the great essential is durability and water-proofing qualities. The test of time has shown that the varnish which best accomplishes the desired results is a varnish of hydrocarbon base, which dries quickly and remains indefinitely soft and plastic. This quality enables a varnish to withstand the contraction and expansion always present in a street railway motor, and prevents the breaking of the insulating film from vibration and heat, thus absolutely and indefinitely repelling moisture, which, in a majority of cases, is the direct cause of short circuits and burn-outs. The "double-dipping" method described above is absolutely essential in the treatment of street railway motor armature coils.

In street railway work it is also essential that a finishing coat of varnish be given the armature after the coils are assembled, as very often injury to the insulating film results from placing the coils into the slots. This coat of varnish not only serves to remedy any defects of this nature, but also provides an additional waterproof coating to the whole armature. A varnish of this nature to be successful should have in a great degree the qualities of dipping varnish, such as ability to withstand long continued heat and vibration without becoming brittle and absolute waterproofing qualities.

* From "The Insulator," published by the Standard Varnish Works.

STARTING A GENERATOR.

Run the generator for a short time with its field circuit open (the field can most conveniently be opened at the rheostat), noting, as in the case of the motor, whether the armature oscillates and the oil rings carry oil. Shut down and replace the field wire in the rheostat, and see that all field resistance is in circuit.

Bring the generator to normal speed, and then gradually cut out the resitance of the rheostat, until normal voltage is obtained. Now note the operation of the machine, and see if the armature still oscillates freely in its bearings; if so, the generator is ready for its load. In case the generator does not build up to voltage when the field resistance is cut out of the circuit (with the generator running at proper speed) it will be found that either the residual magnetism has been lost, or that the shunt fields are not properly connected. In the former case, separately excite the fields from some other source of power for a short time. If, on reconnecting the fields, the generator does not build up, it is probable that the fields are wrongly connected; in this case reverse the leads as indicated on the connection diagrams. Also examine the brushes carefully to see that they make good contact with the commutator. If the machine does not then build up to voltage, an electrician should be called in to locate the trouble.

When the generator is excited to normal voltage, close the main switch. In the case of a shunt wound generator, to maintain the normal voltage as the load increases, it will be necessary to cut some of the resistance out of the rheostat.

In the case of a compound wound generator, if, as the load is increased with the speed remaining constant, the voltage drops to any great extent, it is probable that the seires coils are opposing the shunt, and it will be necessary to reverse the series leads.—Allis-Chalmers Instruction Book.

TURBO-ALTERNATOR PLANT IN GERMANY.

An interesting steam turbine plant has been installed at the power house of the J. A. Maffei Locomotive Works at Hirschau, Munich, in Bavaria, as described in the Electrical World. The steam turbine was built by Melius and Pfenniger, Munich, and develops 1,000 horse-power, being directly coupled to two 250 kilowatt direct current machines. The normal full load speed of this unit is 2,459 revolutions per minute. During a test made with a steam consumption of 17.1 pounds per kilowatt hour the steam pressure was 176 pounds per square inch above the atmosphere, the absolute steam pressure at the stop valves being 191.1 pounds, the actual steam temperature being 319.4 degrees C. (607 degrees F.), and with a vacuum of .484 pounds per square inch absolute pressure. The design of this steam turbine was based on a combination of the action or impulse principle at the high pressure end of the machine and the reaction principle at the low pressure end, fixed guide blades being provided at the high pressure end with the admission of steam over only a small portion of the circumference, working on the partial admission method. The diameter of the drum is, therefore, large at the high pressure end, with a step-down for

the beginning portion of the reaction part of the turbine. It is said that there is not only a gain from low cost of construction, but also a gair in economy by employing the mixed impulse and reaction principles in designing this turbine. With the two electrical generators disconnected and the turbine running alone, the steam consumption was found to be 582 pounds per hour, during a test, with a vacuum of .55 pounds per square inch absolute pressure, and absolute steam pressure of 186 pounds and actual steam temperature of 238 degrees C., the speed of the turbine being 2,505. With the two dynamos connected and delivering a load of 400 kilowatts, the steam consumption was 7,055 pounds per hour, or 17.5 pounds of steam per kilowatt hour. In this instance the speed of the turbine was 2,469 revolutions per minute, the absolute steam pressure 189 pounds, and the steam temperature 312.4 degrees C. (594 degrees F.), while the vacuum was .43 pounds per square inch absolute pressure. On account of two dynamos being used instead of one, there were undoubtedly higher electrical losses as well as higher frictional losses than if a single generator had been employed. It is also held that the turbine was underloaded at 500 kilowatts when a steam consumption of 17.2 pounds of steam per kilowatt hour was recorded, and that at 600 kilowatts output the machine would have shown the decreased consumption of about 16.6 pounds per kilowatt hour.

A RESUME OF WHAT IS KNOWN ABOUT RADIUM.

Sir Oliver Lodge in the "London Times" gives the following resume of our knowledge of radium: "The evidence for the generation of helium may be briefly summarized thus: Rutherford measured the magnetic deflection of the a-rays, or positively charged particles shot off by radium emanation at a certain stage of its disintegration (for it does disintegrate, it is not permanent), and inferred that the mass of each particle was comparable with twice that of an atom of hydrogen; consequently that the projected particles were material, and that the projected matter, if it were any single known subtsance, must be either hydrogen or helium, and most likely helium. Ramsay and Soddy then inclosed some of the emanation in a vacuum tube, and examined its spectrum. There was no sign of helium at first—as there would have been had it been merely an ingredient in a mixture—but the helium spectrum gradually made its appearance, in the course of a day or two, at approximately the rate to be expected on the disintegration hypothesis. The loss of much activity by radium when its emanation is removed from it and the gradual return of radio-activity when time is allowed for fresh emanation to be formed, are also facts to be remembered. The rest of the evidence for the slow disintegration of atoms is of a less direct kind, but it is voluminous and varied, and it seems to me that this evidence is extremely weighty."

A joint deputation from Penetanguishene, Collingwood and Midland has applied to the Power Commission for permission to develop power at Big Chute, on the Severn River, for municipal purposes. Several applications by private parties have been made for this power.

THE STATIONARY ENGINEERS' ACT.

The Canadian Manufacturers' Association have addressed the following letter to its members:

Toronto, May 11th, 1907.

Dear Sirs:—

The Association has pleasure in forwarding you herewith a copy of the new Ontario Act respecting Stationary Engnieers passed at the session of the Legislature just closed.

If you are conversant with the measure enacted a year ago, you will recollect that in many respects it was far from satisfactory, although as finally passed it was a vast improvement over the form in which it was originally introduced, owing to the effective work of our Association. Perhaps the most objectionable feature about it was that it was put through as an amendment to an old Act incorporating the Ontario Association of Stationary Engineers, thus delegating to a private organization powers that should be exercised only by the Government. As an employer of labor you will readily appreciate the serious difficulties that might have arisen in the engineering trade had the law been left in its former shape.

Early in the year the Parliamentary Committee of the Association made strong representations to the Ontario Government on the subject, with the result that an entirely new Bill was introduced and finally passed in the form enclosed herewith.

Being a Government Act, the administration of the law is now taken over by the Department of Agriculture, so that it will no doubt be enforced fairly in the interests of all classes concerned.

Other features which have been incorporated into this legislation, largely through the representations of your committee, during the present session and a year ago, are:—

(1) Steam heating plants operating at a pressure of 20 lbs. or under are to be exempted from the operation of the Act.

(2) In cases of emergency a person who is not the holder of a certificate may be employed in operating a steam plant for a period of 30 days.

(3) Liberal provision is made for issuing, without examination up to July 1st, 1908, certificates of competency to experienced engineers.

(4) Certificates of competency thus issued will be for life or during good conduct. No examination will ever be called for.

(5) The Act does not apply to firemen working under the personal supervision of a certificated engineer, nor to employes of engine builders engaged in installing or testing steam plants.

All of these are points the importance of which you as a manufacturer will readily appreciate. They furnish another illustration of the manner in which the Association is safeguarding your interests in matters of legislation.

Yours faithfully,

A. S. Rogers,
Chairman Parliamentary Committee.
G. M. Murray,
Secretary.

KAMINISTIQUIA POWER RIGHTS.

By a decision of the Provincial Government the protracted struggle among the various claimants to the water power at Kakabeka Falls has been finally settled. For years the wierd names of the Kakabeka Falls, on the Kaministiquia River, near Port Arthur and Fort William, were the polysyllabic subject of interminable oratory before the Private Bills Committee of the Ontario Legislature and in the House itself. The controversy was principally between Edward Jenison, the original grantee, and his assignees, and the Clergue interests at Sault Ste. Marie. Finally the Government has decided that the Kaministiquia Power Company, assignee of the Jenison interests, which has gone on developing at the falls, shall be confirmed in its rights at Kakabeka Falls. It must, however, pay the Government a certain fixed rate a horse-power a year on all power developed at the falls in excess of 10,000 horse-power. The Provincial authorities, on their part, will build, maintain and control a dam at Dog Lake for storage purposes. The Government will also regulate the flow of water from that lake for the benefit of all the water-power developments in the river, including the one at the Kakabeka Falls.

Enclosed Station Wiring

By F. O. Blackwell.

High tension transmission was the subject for discussion at the special meeting of the American Institute of Electrical Engineers in the Auditorium Hotel, Chicago, on May 24th. It was the largest meeting ever held by the Chicago branch, about 200 being present. Discussion of high tension problems was based on five papers, as follows: "Relative Merits of Three-phase and One-phase Transformers," by H. W Tobey, of the General Electric Company; "Relative Advantages of One-phase and Three-phase Transformers," by John S. Peck, of the British Westinghouse Company; "Potential Stresses as Affected by Overhead Grounded Conductors," by R. P. Jackson, of the Westinghouse Company; "Forced Oil and Forced Water Circulation for Cooling Oil-insulated Transformers," by G. C. Chesney, of the Stanley Electric & Manufacturing Company; "Open vs. Enclosed High-voltage Station Wiring," by F. O. Blackwell, of New York. The papers and discussions were not presented as covering the whole field of the subjects discussed, but brought out the salient features on which differences of opinion might exist.

The following is an abstract of Mr. Blackwell's paper on "Enclosed Station Wiring" and the subsequent discussion thereon, for which we are indebted to the Western Electrician:

In the power house of a few years ago, when the amount of power was relatively small, a short-circuit was not a serious matter; but to-day, with 50,000 or 100,000 horse-power concentrated in one plant, a much higher standard of station wiring is called for.

With a large amount of power the destructive ability of an arc is enormously increased, and the use of high potentials has made it possible for arcs, once started, to jump almost any distance if not confined.

The direct loss of income is large, but this is nothing to the indirect loss due to the depreciation in the selling value of the power output, caused by loss of public confidence in the reliability of the service.

The metal vapor from an arc, even after the current has been interrupted, will often short-circuit conductors at a distance from the point where the arc started. Wires of high potential circuits which are as far apart as it is possible to have them inside of a building, may be affected by arcs between low potential conductors beneath them. Lightning striking in the neighborhood of a transmission line has been known to cause a short-circuit after the discharge was over, due to the path of hot gas floating across the wires.

In order to prevent the occurrence of short-circuits, and to localize the damage should an arc start from any cause, the following elementary principles should be observed:

1. The system of connection should be as simple as will give the necessary control over the station.

2. The conductors should follow the shortest and most direct line from generator to transmission line.

3. Each conductor should be surrounded and separated from every other by a continuous fireproof barrier.

4. The circuits should be as far apart as possible.

Enclosed wiring has already become the accepted practice in important low tension plants of from 2,000 to 15,000 volts, but is not used as generally for higher potential, where the writer believes it is much more important.

Low potential insulated cables, drawn through ducts or enclosed by split-tile or pipe coverings, are safe, provided care is used to cover the cable joints at the manholes, as a cable joint is a frequent source of trouble.

A single cable tunnel, or duct system, with common manholes, through which all the cables in a plant run the length of a building, is often employed, in which, if anything goes wrong with one cable the entire power house is disabled. Accidents of this kind might be avoided by keeping the cables from each unit in a conduit at a distance from other circuits, and laying out the wiring so that each generator can be operated as if it were in a separate power station.

Where bare conductors are used on account of many connections, or where the potential is too high for insulated cables, the wires should be enclosed by substantial walls or barriers of brick, concrete, tile or stone, with only such openings as are necessary to get at insualtors or connections. Covers should be provided for all openings.

Discussion.

C. W. Stone remarked that engineers to make a system flexible, put in all sorts of tie connections; then in order to save space and cost they put in knife switches. By putting in the knife switches they accomplish just what they are trying to avoid. The knife switch may be opened by mistake. If it is opened under load by mistake there is a big arc which may be whipped across and involve all the adjacent apparatus. Therefore, if possible, try to keep each individual circuit entirely distinct, with no tie, and if ties are used use enclosed switches—that is, all switches in the form of knife switches must be put in between barriers in order to confine the arc. From Mr. Blackwell's paper it is quite evident one cannot confine the arc if an arc at low voltage will jump 40 feet. By placing barriers between circuits, the jumping distances are shortened, and therefore the barriers must be placed farther apart. This makes it almost prohibitive to install bus bars in a bus bar compartment, because the bus bar compartment becomes as large as the station in order to get the safe jumping distance. It would seem good practice to eliminate all secondary devices whatever from the high potential side, put all instruments on the low potential side, running directly from the transformer, say, or the switch to the line with nothing whatever connected to it.

F. C. Mahrberg thought that with enclosed wiring for 60,000 volts and higher compartments become too large to be practicable. If wires are put far enough apart so that the arc cannot hold, that is all that can be done. For voltages of about 30,000 no doubt bus bar compartments and barriers between bus bar compartments and switches have become the standard

practice. However, it seems that wires and insulators are enclosed more than would seem necessary. Barriers between all wires and between the bus bars would seem to be plenty, with the advantage of having the wires and insulators as conspicuous as possible and as "get-at-able." If the vertical risers from the bus bar compartments to the switches are enclosed any leakage is not detected as readily as if the wiring is open, while insulators cannot be cleaned as readily as they can be otherwise. Instruments and transformers on the high tension side should be omitted where possible. However, if a high tension bus and the individual lines have to be protected, current transformers on the high tension side are necessary.

Mr. Lincoln thought all would agree on the first two points made by Mr. Blackwell, but not so on the statement that "each conductor should be surrounded and separated from every other by a continuous fireproof barrier." Mr. Lincoln said that the principal advantage of enclosing bus bars, wire, etc., is to prevent a destructive arc from forming in those bus bars, etc. The higher the voltage of a station is the less destructive becomes the arcs. With 2,000 volts the destruction is about maximum. Therefore, in building any 2,000 volt bus bars for even a moderate amount of power they should be enclosed by all means; but for the same amount of power at 60,000 volts or at 40,000 volts the same thing does not hold. The destructiveness of an arc is in proportion to the volume of current, and the higher the voltage the less the amount of current available for producing destruction. That is one very good reason for omitting these fireproof barriers at some point as the voltage goes up. Another obvious and very good reason for omitting them is the difficulty of obtaining insulation as the voltage goes up.

E. N. Lake illustrated on the blackboard the construction of a small rotary sub-station operating at a potential of 25,500 volts, which accomplishes the points of the paper.

Mr. Mahrberg said that for sub-stations it seems that the arguments that are advanced for separating the wires do not hold good as in the case of main stations. If the 20,000 or 30,000 volt transmission line is first introduced into the circuit where the conductors cannot be separated there seems little gain in separating the conductors after they enter the building. If the building is fireproof the arc that might be set up can do but little damage. It would introduce a rather expensive construction to separate all the wires on every 200 or 300 kilowatt rotary sub-station.

H. C. Hoagland, of the Illinois Traction Company, stated that where wires are placed reasonably substantially the company had very little trouble with the wiring inside the station under regular circumstances. Its troubles were always due to disturbances other than the wiring.

Mr. Jenkins said that with a 60,000 or 50,000 volt system of a capacity of perhaps 60,000 kilowatts and a reasonable number of distributing circuits, every precaution has to be taken against accidental contact, and if a large station were put up without barriers in a working construction force of 50 to 100 men there would be quite a number of troubles. On the higher potentials it is not possible to get oil switches which are equipped with disconnecting appliances. Therefore one is forced to install knife switches outside the oil switch, which on the high potential again calls for a barrier. In some cases his company provides the barriers and then insulates the conductors inside the barriers. Mr. Jenkins thinks that barriers should be used in all cases, and that the effect of the short-circuit is greatly decreased, even though the arc holds between the conductor and the barrier.

F. Woodmansee thought that in a sub-station at the end of the line it was only necessary to insulate the wires from each other, as there is little liability of anything getting across the wires to cause a shut-down. Consequently, the additional expense is not warranted in separating between polarized lightning arresters or anything which may cause an arc in its operation. But in the power house proper, where the question of keeping the potential on the bus bars is very important, and where there are a number of men working in the station, the bus bars should be separated from each other by some fireproof barrier. In a good many cases the stations are made much more complicated than they should be. The question of running leads from bus bars is a very important point to consider. It is oftentimes easier to insulate the bus bars and run them lengthwise of the station and thus cut down a good many feet of cable which would otherwise be required. These can be run and protected in such a way that it is almost practically impossible to give trouble.

Mr. Lincoln gave it as his opinion that the general modern tendency is rather toward doing away with all buildings than putting buildings around every individual wire and piece of apparatus in a station. The time is coming when the bus bars, transformers, switches, etc., will be put out in the weather and a building put around only such apparatus as must absolutely be housed, such as instruments. Space up in the air is very easy to obtain. All that is necessary is to put the station out of reach. An ordinary transmission line is not considered dangerous; it is out of reach. Exactly the same thing can be done with the sub-station. If it is logical to put fireproof barriers around the individual wires in a sub-station, it is just as logical to run those fireproof barriers clear back to the generating station. That reduces the fireproof barrier proposition to an absurdity.

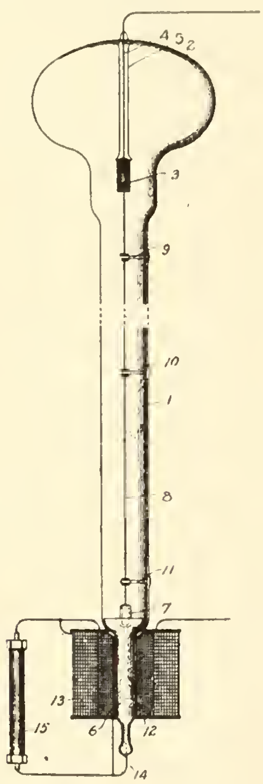
W. B. Jackson remarked that where it is possible for the wires to be touched by the employes in the regular performance of their duties they must be protected by the fireproof compartments or by separating walls of some kind, but as soon as the wires get out of that zone let them be free.

D. C. Jackson told of stations in certain of the western towns. They have a step-down sub-station where the building consists practically of a light wooden framework covered with corrugated iron, and the line that passes over it drops down through the roof through a suitable terminal.

The wiring is run to transformers through ordinary fibre conduit, using the usual linen covered wire. That makes a sub-station that comes as near simplicity as is possible. It is almost the equal of having the whole thing out of doors. Perhaps it is even cheaper than to erect the structure on an elevated platform, and it also protects the transformer terminals and such switching terminals as are needed from the weather.

INVENTION and DEVELOPMENT
IN THE ELECTRICAL FIELD

Heating Attachment for Mercury Arc Lamp.—Mercury arc lamps and similar apparatus when operated under conditions where they may be subjected to a relatively cold surrounding atmosphere—as, for example, when operating out of doors in winter—sometimes start with difficulty. In order to overcome this difficulty Dr. Charles P. Steinmetz of Schenectady has invented means for pre-heating the lamps or other apparatus, so that in cold weather they will be able to start without difficulty. This attachment is



Heating Attachment For Mercury Arc Lamps.

automatic, so that it will be cut out of circuit after a moderate predetermined interval.

The mercury lamp shown in the drawing is of a well-known type and requires but a brief description. The exhausted glass tube or envelope of the lamp is indicated at (1). This tube is surmounted by an enlargement or bulb (2), constituting a condensing chamber. An anode (3) of artificial graphite or other suitable material is mounted at the mouth of the upper end of the tube and is supported in position by a depending wire, the upper end of which in the usual manner is sealed through the glass of the bulb and constitutes a current-leading-in conductor. The exposed portion of this wire is surrounded by a protecting glass tube (5).

The lower end of the tube is contracted to form an extension (6). A body of mercury forming the cathode of the lamp fills this extension and to a slight depth spreads over the lower end of the tube (1). A float or plunger (7) of soft steel or other suitable magnetic material is immersed in this fluid, with its upper end projecting from the surface, as indicated. This upper end is hollowed out so as to form a cup. After the plunger has been once submerged and has come to the surface it is filled with mercury.

A filament (8) similar to the ordinary incandescent lamp filament is supported from the anode (3) and passing down through centering guides dips at its lower end into the mercury held in the cupped upper end of the plunger (7).

A lamp such as described is ordinarily started, says Dr. Steinmetz, by means of a solenoid located about the extension (6) and in series with the lamp circuit. This solenoid when energized pulls down the plunger (7) and by thus causing an initial arc at the lower end of the filament (8) puts the lamp into normal operation.

But the present invention provides a heating coil located, in addition to the starting solenoid, about the extension (6). This heating coil is indicated at (12) and the starting solenoid at (13). These solenoids or coils are represented one inside the other. The heating coil may be of relatively small conductor, and is preferably located next to the lamp tube, as indicated, though, if desired, the coils may be otherwise arranged. The coils are connected in series with each other and by means of the leading-in conductor (14) with the lamp proper. The heating coil (12) has approximately the same number of turns as the starting coil, but is wound in the opposite direction. It is shunted by a resistance (15), the temperature resistance coefficient of which is negative. This resistance is preferably made of magnetite. The magnetite may be arranged in the form of a baked stick, or it may be in powdered form and compressed within a tube having suitable terminal connections. A quantity of powdered mica may be mixed with the magnetite powder, if desired. This mica, among other properties, has the advantage of preventing agglomeration of the powdered magnetite and consequent permanent variation of resistance.

When current is turned on to the lamp the resistance of the magnetite member (15) being, when cold, extremely high, causes practically the entire current to pass through the heater coil. The heater coil and the actuating or starting coil being, as already noted, wound in opposition to each other have no resultant magnetizing effect. The heater coil thus rapidly imparts heat to the lamp structure and takes away the undue chill, which is detrimental to the starting of the lamp. The parts adjacent to the mercury in the lamp are thus heated up. The current traversing the filament (8) heats this filament to redness, and thus heats the upper part of the tubular member of the lamp.

The magnetite member is so proportioned that its voltage—that is, the voltage at which it short-circuits—is slightly below the voltage consumed by the resistance of the heater coil (12), about which it is shunted. Therefore for a short time and somewhere in the neighborhood of one-quarter of a minute or more, the main current passes entirely through the heater coil.

By the time this period has elapsed the current, though small, which passes through the magnetite heats the latter and rapidly reduces its resistance until a condition is reached where the magnetite forms practically a short circuit about the heating coil (12). The actuating or starting colenoid (13), then largely overpowering the counter magnetizing effect of the heating coil, pulls down the plunger (7), and the parts then being relieved of their chilling temperature readily starts the lamp.

The resistance of the magnetite element varies greatly in temperature and is very much higher near 0° F. than in warm summer weather Therefore such a magnetite element will short-circuit the heater coil in summer time almost instantly or within a second or so, but in winter will keep it energized for a quarter of a minute or more. The heater action of the apparatus is thus automatic, since in summer, when no such heating action is required, the heater coil is cut out of action almost instantly, whereas in winter, when such heating action may be necessary, the heater is maintained in circuit for such a moderate time as is necessary for it to perform its function. The invention is patented.

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Triple Motor Generators.—An interesting balancer has been installed in the power station of the Blankenese-Ohlsdorf line of the Hamburg (Germany) Metropolitan & Suburban Railway. It is described briefly in the Electrical Review (London), May 3rd, by Alfred Gradenwitz. The machine is designed for generating single phase alternating current of twenty-five cycles for operating the railway, an alternating current of fifty cycles for lighting, and direct current for exciting the alternators and charging the exciting battery. It is connected as a balancer across the three circuits, so that at times it draws power from the twenty-five cycle circuit, the fifty cycle machine running as a generator; and at other times operates in the reverse sense. The machine may also be driven by the direct current generator running as a motor and drawing its supply from the batteries; but is generally used in this way only for starting purposes. The rotors of the three machines are mounted on the same shaft, the two revolving fields being placed side by side between a single pair of bearings, the direct current armature being at the other end of the shaft between the central bearing and a second outboard bearing. The two alternators are each rated at 600 kilowatts, 6,300 volts, when operating as generators. The direct current machine is rated at 250 kilowatts, 220 volts. There is a smaller machine of the same kind, in which the twenty-five cycle section is rated at 250 kilowatts, and the fifty cycle part at 150 kilowatts.

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Electric Light Bulb.—Mr. D. F. Campbell, electrician, of Victoria, B.C., received recently a United States patent on an improved incandescent electric light bulb. The invention is designed to reflect downward the rays of light from the filament of the lamp, and to disperse them in that direction instead of having them concentrated on an unlimited area. Furthermore, the reflecting surface is projected within the circle of the filament, so that interference of the rays of light from one side of the filament with those from the other is obviated. These objects are attained by providing a bulb of peculiar form, the lower surface of it being a segment of a sphere of relatively larger diameter, and the upper surface a similar segment of similar diameter, the convexity of the upper segment projecting within the concavity of the lower one. The filament is of ring form and surrounds the inwardly projected portion of the upper side of the bulb. The silvering is applied to the outer surface of the upper side of the bulb to show a reflecting surface from its downward convexity. One important advantage of this construction which differentiates it from other attempts to attain a similar result lies in the fact that the reflecting material is fully exposed to the atmosphere, so that it cannot become overheated by the filament and destroyed.

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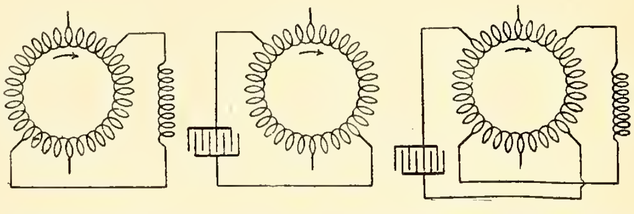
Self-Starting Single-Phase Induction Motor.—A patent issued April 30th to Mr. Ralph D. Mershon describes a method for obtaining a uniformly or approximately uniformly rotating field in a single-phase



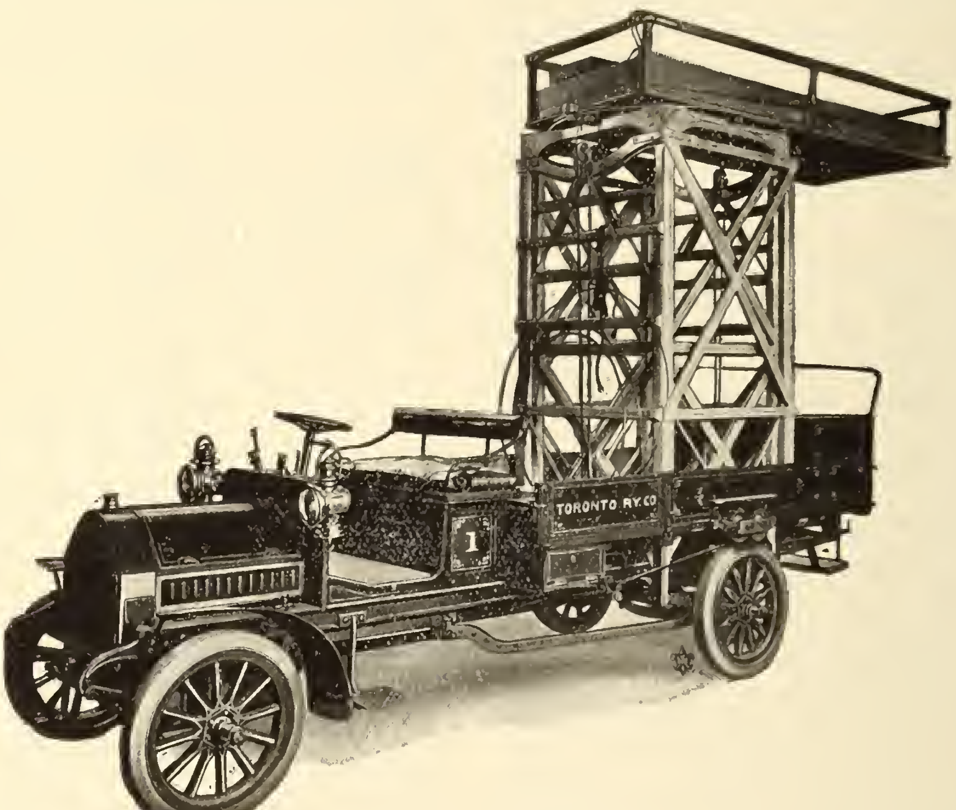
Mershon Self-Starting Single-Phase Induction Motor.

induction motor under starting conditions. The elements of the scheme are shown in Figs 1 and 2, while the complete device is indicated in Fig. 3. Fig. 1 indicates an inductive reactance connected to the primary element of a two-pole single-phase induction motor across an electrical diameter at about 45 electrical space degrees from the main terminals. It is stated that with this connection an unsymmetrical rotating field is produced, giving a torque in the direction indicated by the arrow. No explanation is given as to the causes for the mechanical movement of the field or as to the source of the torque. In Fig. 2 a conductive reactance is substituted for the inductive reactance of Fig. 1. According to this connection an unsymmetrical revolving field will be produced, and on account of the electrical space displacement of the condenser circuit from the main terminals the tendency to rotation will be in the same direction as indicated in Fig. 1. The inventor proposes to combine the action obtained with the connections of Fig. 1 with that of Fig. 2, as indicated in Fig. 3. It is claimed that by properly proportioning the values of the inductive reactance and the condensive reactance, the rotating field in the motor will be approximately uniform, so that a maximum starting torque is obtained. By giving to the capacity of the condenser a sufficiently high value, the leading current which it takes directly from the main circuit and the exciting force which it supplies to the magnetic field may be made to compensate for and reduce the lagging magnetizing current in the supply circuits of the induction motor, and thus the power factor may be given any desired value under running conditions. Evidently the best results will be obtained when the inductive reactance is omitted.—Electrical Review.

Electric Railway Department

GALT, PRESTON AND HESPELER RAILWAY IMPROVEMENTS.

The Galt, Preston & Hespeler Railway Company, which also owns and operates the Preston & Berlin Railway, is double-tracking its line between Galt and Preston, Ont., installing a 750 horse-power addition to its power plant at Preston, and adding to its rolling stock a 35-ton electric locomotive and four suburban cars to replace the rolling stock destroyed by fire December 3rd last. The cars will be 55 feet long with a smoking room compartment 10 feet 7 inches. The green opalescent glass; the transom, which extends over the length of the two lower sashes will be glazed with blue opalescent glass, particular attention being paid to the harmonization of colors and shades. The waist panel, or that part of the wall from the window sill to the floor, will be covered with painted burlap. In the upholstering of the seats in bronze green, special attention is being made to have them sanitary and yet attractive in appearance. The ventilator sashes are equipped with a sash opener, by which the conductor can ventilate the car in a few minutes with-



An Overhead Trolley Construction Motor, as used by Toronto Street Railway. 16-20 H.P. Motor. Speed, 18 Miles.

passenger and smoking compartments will be furnished with twenty-four reversible and eight stationary automatic seats with tilting cushions. The foot rests underneath the seats are movable, so that when the seat back is moved it allows the foot rest at the back to drop to accommodate the passenger sitting immediately in the rear. Polished bronze grab handles are on the aisle-end top corner of each seat back. The interior finish will be polished mahogany inlaid with white holly and ebony. The design is of the most modern character, presenting a smooth surface, highly polished and having none of the unsanitary features so frequently found in cars of this description, all raised mouldings and projections being eliminated as far as possible, commensurate with appearance. There will be a basket rack over each seat. The door between the passenger and smoking compartments will have spring hinges and patent door checks. The ceiling will be "Semi-Empire," painted a delicate green. The deck sash will be glazed with out any draft on the passengers, giving a free circulation of pure air in the upper part, thus eliminating all danger of drafts. The lower sashes are designed so that the more vibration there is, the tighter they become, being fitted in the top with O. M. Edwards Company's spring compression rollers, and at the bottom with special bevelled locks, which force the sash frame against the framework of the car, making it practically air-tight and effectually preventing all rattling.

The vestibules at each end are five feet long, and equipped with automatic folding doors. As it is now against the Ontario Railway Act to allow any passenger to ride with a motorman, the cars are equipped with a motorman's cab, the door of which is so arranged that it can be folded back against the end of the car, effectually shutting in the controller and brake equipment. The motorman's seat in the tail end of the car can be used for a passenger when necessary. In one end will be located a tastefully designed

incased cabinet, in which all the switches will be located.

The exterior will be painted Pullman color, trimmed with gold. Possibly the greatest attention of all has been paid to the underframing work. The side sills are composed of ⅜ x 18 inch steel plate reinforced with wood, and extending the full length of the car body. This is also over-trussed and under-trussed with a combination of angle steel and wrought iron, eliminating all danger of deflection of the car body. The centre sills are also composed of continuous steel plates, extending from end to end of vestibules, blocked with wood. The intermediate sills are further strengthened by 6 x 4 inch steel angle, extending backwards a sufficient distance under the car to prevent any drooping at the points of the vestibules. Immediately under the bulkhead at each end of the car is placed a 6 x 4 inch steel angle, extending from side to side of the body. This angle iron is intended to transmit the strain borne by the over-truss, and prevents any sagging in the centre of the car. The needle beams are made of 6 inch I beams, fitted on the ends with malleable iron struts, conveying the weight to the under-truss rods. From the belt rail to the top of the sill, the car is blocked solidly with whitewood blocking, this making the side in one solid frame. The system of bracing used in this side framing is what is technically termed W bracing. Each car is equipped with a pilot at each end and radiating drawbars. At diagonal corners, steps are provided, having three risers, bringing the lower step quite close to the ground. All the glass, with the exception of the opalescent, is to be polished British plate, one-quarter inch thick. The trimmings are to be solid bronze, highly polished. The curtains or window shades will be morocco embossed back, mounted on O. M. Edwards Company's tin spring shade rollers, and fitted with roller tip, pinch handle curtain fixtures. An electric signal bell system is to be provided with a push button at each seat.

Instead of having the usual incandescent lamps with their continual alternating dimming and brilliancy, so hard on passengers' eyes, four interior arc lamps will be used. In heating every provision is made to keep passengers comfortable. An electric heater is provided under each seat, and one in the motorman's cab. Fire extinguishers will be placed in each vestibule, and each car will be equipped with an arc headlight. Storm sashes will also be a feature. They will be put on in such a way in the winter that they will not in the least detract from the appearance of the car.

The Westinghouse automatic air brakes will be installed on each car, as well as an auxiliary hand brake. The electrical equipment consists of four Westinghouse 93-A-60 horse-power motors, speeded at 45 miles an hour. These cars are also having a complete multiple unit switch control equipment.

The Toronto & York Radial Railway Company have completed their electric railway to Jackson's Point.

The New York & Ontario Power Company, whose plant is at Waddington, on the New York side of the St. Lawrence River, has made an offer to the Hydro-Electric Power Commission to supply electric power for the city of Kingston and adjacent municipalities, the company being permitted by their charter to dispose of a portion of their power on the Canadian side. The Commission, however, has received no formal application for power from the municipalities in the vicinity.

PORTABLE TRANSFORMER STATION.

The Street Railway Journal gives an account of one of the interesting features of the three-phase system used on the Valtellina Railway, Italy, viz., a portable transformer sub-station which is used either to take the place of a stationary transformer station when the latter is undergoing repairs or to help out portions of the line carrying unusually heavy loads. The transformer, which is of 430 kilovolt-amperes capacity, is mounted in a freight car built entirely of iron. The car body is divided into two unequal portions, the larger of which contains all the high tension apparatus, as follows: Transformer, electrically-driven ventilator, three-pole hand-operated cut-out switch, three-pole automatic 20,000 volt oil switch, three two-pole hand-operated 3,000 volt oil switches, three automatic cut-outs, relays, lightning arresters, and choke coils. The smaller compartment contains three handwheels for the oil switches of the secondary circuit and a handwheel for the primary switch, as well as the bell and lamp signal apparatus of the relays which immediately indicate the cut-out switch opened. In this case three secondary switches had to be installed, as at one point on the system the transformer station supplies current to three lines. Insulators are on the roof for both the primary and secondary circuits. The portable transformer station can be connected to operate without auxiliary resistances in parallel with a stationary transformer, in which case the current divides in the ratio of 43 to 30. This scheme, says our contemporary, has been a success even in cases where this parallel connection was made from a substation more than 3 km. distant, and not at the place where some fixed transformer was cut out of the circuit.

THE "PAY AS YOU ENTER" CAR.

In the May number of THE CANADIAN ELECTRICAL NEWS there appeared a statement which might give the impression that the "Pay-As-You Enter" car as adopted by the Montreal Street Railway is not a success. This is contrary to fact, as we understand that the management of the Montreal Street Railway express entire satisfaction with the operation of the car. Representatives of almost every large street railway system in America have visited Montreal for the purpose of seeing the car and ascertaining its practicability in their own city, and without a single exception they stated that it was the only car they had ever seen which prevented the missing of fares. The Montreal Gazette of May 30th contains the following reference to one of these visitors: "The president of the Detroit street railway visited Montreal the other day and was so much surprised with the Montreal Company's new cars that he announced on his return home that he would introduce them in the local system. If he does, and incidentally gives Detroit as good a service as Montreal possesses, he will put the three-cent fare agitation out of business."

It is stated that the project to build an electric railway from Toronto to Kingston has been abandoned, the time for the commencement of the work in order to save the charter having expired.

A catalogue of direct current generators and motors has reached us from the Barrett Electric Manufacturing Company, Cincinnati, Ohio. Besides the machine descriptions, the catalogue contains general information, rating of motors, etc.

TELEGRAPH and TELEPHONE

SIMULTANEOUS TELEGRAPH AND TELEPHONE.

By George Black, Hamilton.

In the May number of The Canadian Electrical News you published an article on the above subject which presumably represents the latest methods of accomplishing that object.

The present paper sets forth the first demonstration of the same, invented by the writer in 1878. A comparison of what was achieved then and the present practice will no doubt be interesting to your readers.

The first attempt was to keep up telephone communication with the writer's house over a local city telegraph line equipped with 20 ohm main line sounders, and as the resistance of the telephones could not be added to that of the line, the phones were tapped on line and grounded through a condenser of very slight capacity. This worked very nicely, but when an operator used the line the phone could not be conveniently held to the ear, nor the voice heard (see Fig. 1). To overcome this difficulty a condenser of very slight capacity, the only one available at the time, was shunted around the telegraph instruments, but did not produce the desired effect.

It must be remembered that at that date very little was known of the telephone, technically—only the receiver was invented, which was used both for speaking into and listening. No toll lines were in existence —only grounded single wires being used—and the want of double transmission was not felt, as leased telegraph wires were probably unknown. An effort was made to enlist the interest of district telegraph companies, to use phones in connection with their call lines—one particular signal being arranged to mean "answer on telephone"—but no one would take hold. Such a use had been demonstrated and different circuits were joined together by means of condensers acting as perfect repeaters.

Some time afterwards an adjustable condenser of four or five micro-farads capacity was procured and the original experiment was repeated, shunting the instruments, with complete success. The discharge or "break shocks" caused by telegraphing at the home or near station was completely subdued. Figure 2 shows the improved method.

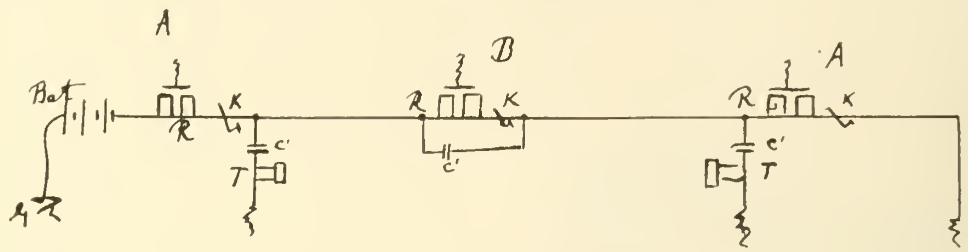


Fig. 1.

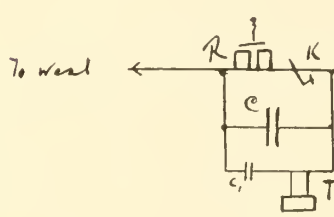


Fig. 2.

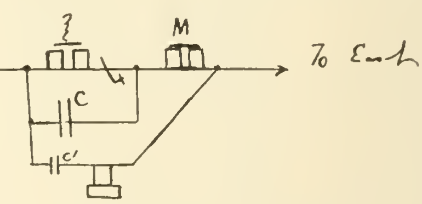


Fig. 3.

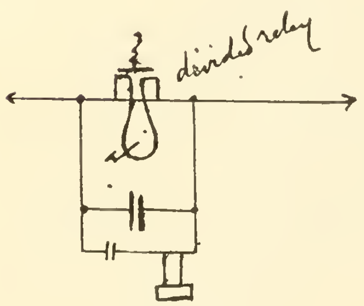


Fig. 4.

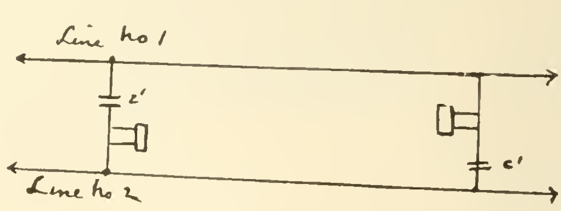


Fig. 5.

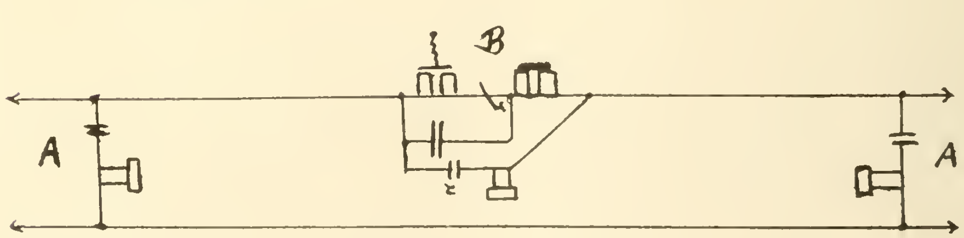


Fig. 6.

R, relay; K, key; C, large condenser; C1, small condenser; M, extra electro magnet; A, terminal station; B, intermediate station.

Diagrams Illustrating Mr. Geo. Black's System of Simultaneous Telephony and Telegraphy.

In these diagrams only the essential parts are shown —main and local batteries and sounders are omitted, telegraph instruments represented by relays and keys. Telephone apparatus by the receiving phone, which was all we had in those days.

It was found by experiment that the desired effect could be obtained with less condenser capacity if a second relay or electric magnet of like conditions was inserted in the circuit, as shown in Figure 3. The second magnet, however, could be dispensed with, thereby keeping the resistance of circuit down, by dividing the relay wires in the middle and inserting the key between the coils (Fig. 4).

As a metallic circuit was desirable for telephonic purposes, the following arrangement of two telegraph lines and one telephone circuit was devised (see Fig. 5), in which the telegraph instruments and large condensers are omitted to simplify the figure. This arrangement proved very satisfactory, and was used

MR. GEO. BLACK,
The Original Inventor of Simultaneous Telephony and Telegraphy.

for years between Hamilton and Toronto, a distance of 40 miles.

To introduce an intermediate office for both telegraph and telephone, see Fig. 6. This also worked perfectly.

A number of other devices were arranged to suit other conditions, but need not be enumerated here. Suffice it to say that the double transmission worked well, and scores of persons tested its practicability during the time it was in use between Hamilton and Toronto.

The system was installed between certain stations on the Staten Island Railway, also between Windsor and Detroit for the Grand Trunk Railway, and between Sarnia and Forest on the Grand Trunk, connecting a bank and its branch.

A United States patent was obtained in 1879, but few of the improvements were included. An attempt was made to interest telegraph and telephone companies, but the Western Union and Bell Company had a working agreement which forbid either entering upon the business of the other, and as one party was opposed to working the invention jointly the scheme fell flat. Had they taken hold, long ditsance telephoning could have been established earlier and immense sums saved in construction alone and all parties benefitted.

Some time later Van Ryssalberghe, of Belgium, brought out his system, and, having read papers on the subject before various scientific societies, which were published in their transactions, he got full credit as the first inventor, but that the system here described was the first demonstrated cannot be disputed.

In an article in your May number by Messrs. Slough and Taylor, they say: "For a long time the first expense for apparatus used for simultaneous telephone and telegraph service retarded commercial recognition of its industrial value, etc., etc." They could not have been familiar with this system, as the cost of condensers and extra magnets is only slightly over the apparatus they describe, and very small when the income from leased telegraph wires is considered.

The capacity of the condensers used for shunting the telegraph instruments ran from 2 to 5 M.F., and the small ones for establishing and preserving the telephone circuit only a fraction of one M.F.

A GIANT TELEPHONE POLE.

One of the tallest telephone poles in the world is where the wires of the Pacific Telephone Company cross the Chehalis River, near Aberdeen, Wash.

For some years past a pole 90 feet high was sufficient to keep the wires clear of river craft. But the increasing passage of ocean steamers made a higher pole necessary, and a new one 126 feet high was set up. This pole is one single stick of Washington fir, 18 inches at the butt and eight inches at the top. The pole weighs 6,000 pounds.

The stick was cut at a point 12 miles distant and towed down the river, where it was erected by six men, using a 12 horse-power hoisting engine. The American Telephone Journal says that for making attachment to the pole and moving it a five-eighths inch steel cable was employed, run through 10 inch steel blocks.

The pole was set 12 feet in the ground and guyed with four steel stranded wires at the top, and also guyed about 40 feet from the top with four five-sixteenths inch stranded wires. The guys are fastened to dead men set in the ground to a depth of eight feet. These dead men are of cedar, 8 x 8 inches in section and seven feet long.

CEMENT-COVERED TELEGRAPH POLES.

Experiments which were made in India some three years ago in covering wooden telegraph poles with cement, put on in a thick coat over wire netting securely fastened to the pole, are said to have been satisfactory, and to have afforded absolute protection against that pest of tropical countries, the white ant. ing glas stube (5).

The Belgian inventor, Carbonelle, has succeeded in electrically transmitting portraits, letters, etc., between Brussels and Antwerp, a distance of 27 miles, but instead of a photograph, it is an impression on a half-tone block which is transmitted and which will print in fine paper. The two instruments serve indifferently for sending or receiving, and the cliche or block is obtained in one minute.

THE TELEPHONE IN JAPAN.

A representative of THE CANADIAN ELECTRICAL NEWS recently had the pleasure of a chat with Mr. G. C. Hodge, superintendent of the British Columbia Telephone Company at Nelson, B.C., who has recently returned from a trip through Japan Mr. Hodge relates many interesting facts in connection with the telephone systems of that country. The following are a few extracts from his notebook:

The telephone system throughout Japan is under Government control. The population of Tokyo is 1,000,000 with five telephone exchanges, and Tokyo alone has 15,000 subscribers, and 10,000 on the waiting list. It takes practically seven years after ordering before an individual can get his telephone in. At the present time the orders sent in during 1900 and 1901 are being filled.

The telephone rate at Tokyo is 66 yen per annum, equal to $33; at Yokohama it is 54 yen equal to $27. They have no party lines, and the rate is the same, whether for business houses or for private residences.

The pay of the operators is from 25 to 35 sen per day, which is equivalent to from 12 1-2 to 17 1-2 cents Canadian money. Of course, it must be taken into consideration that the average cost of living in Japan is only one-fifth the cost of living in Canada. Linemen receive from 40 sen to 1 yen per day, equal to 20 to 50 cents, and their uniform supplied. There are about 1,500 calls per operator each day, and there are over 35 operators at the board at the same time.

All the switchboards were manufactured by The Western Electric Company, of Chicago, U.S.A., and are what is known as the "Branch Terminal Multiple," with the exception of the Shitaya Station in Tokyo, which has a visual lamp switchboard, and the exchange at Kyoto, which has central energy. In visiting the exchanges, all visitors have to remove their boots and put on slippers, as the floors are highly polished and are scrupulously clean.

At all the principal corners in the town there is a public telephone booth, with coil slot attachment. The city lines are built of No. 16 copper, and trunk lines of No. 8 copper. The trunk lines are very well constructed. Many of the city poles are built of structural steel, having the cross arm made of angle iron.

A peculiar feature of the pole line is the use of a "pull and push" brace on the main streets, this brace extending in over sidewalks, and compelling pedestrians to pass underneath. Another novel feature of the outside construction is a solid steel bridge, shown in the accompanying photograph, which crosses the canal at Tokyo, and was built and is used exclusively for carrying the underground cables. So far as is known, this is the only bridge in existence built and used specially for this purpose. Mostly all the underground cables were purchased in England and Germany. They are known as air-filled cables, the wires being suspended in air inside the cables.

BRIDGE CARRYING UNDERGROUND WIRES, TOKIYO, JAPAN. PROBABLY THE ONLY BRIDGE IN EXISTENCE USED ENTIRELY FOR THIS PURPOSE.

RAILWAY CONSOLIDATION.

Conditional on exchange of bonds by present bondholders of the Brantford Street Railway Company, Grand Valley Radial Company and the Woodstock & Ingersoll Railway Company for those of the new organizations, plans for amalgamation of these companies and transfer of their interests to new companies have been consummated. The new company will operate under the name of the Grand Valley Radial Railway Company, and is headed by M. A. Verner, capitalist, of Pittsburg. Great improvements will be made by the new management. The track mileage in Brantford will be doubled, and Colborne street double tracked. The system will be extended to Cainsville. A new line will be constructed on private right of way via Burford and Cathcart to Woodstock, there connecting with the Woodstock & Ingersoll line, which will be extended to London. It is also planned to build by private right of way to Port Dover via Mount Pleasant Boston, Waterford and Simcoe.

The application of the Toronto & Niagara Power Company for authority to construct a transmission line from Brantford to London came before the Deputy Minister of Railways on May 28th, and at the request of the City of London was held over for a month to allow the municipal authorities to present their statements. The ground of opposition from the Municipal Union was that the ratification of the route would prejudice the proposed undertaking of the Hydro-Electric Power Commission.

THE COST OF PRODUCING POWER

By L. G. Read,
Managing Director and Chief Engineer, Colonial Engineering Company, Montreal.

The Hydro-Electric Power Commission has promised a rate of from $18 to $20 per annum per horse-power, and, without in any way belittling the commendable motive which has actuated the creditable work done by that Commission, there are, nevertheless, some very pertinent facts which are worthy of most careful consideration by power users before they tie themselves up in a contract for a term of years on a so-called "flat rate" basis.

In the first place, before capital can be justified in the development of water power and the losses and difficulties of long transmission, transforming stations and expensive equipment, the user of that power—the consumer—must of necessity bind himself to a basis in which the minimum amount which he agrees to pay—whether he actually uses the power or not—will justify the investment; that is to say, he must agree to pay for something which, in all probability, he will not use.

For example: A manufacturing company decides to use this power at, say, $20. They put in motors, aggregating 100 h.p., maximum. The motors are tested and rated at, say, 90 h.p., and then the manufacturer signs a contract for three or five years, in which he agrees to pay a minimum charge based, say, on 75 h.p., which, at $20, equals $1,500 per year. Whenever his load line goes above 75 h.p. he pays extra for it, but he gets no credit when it drops—at certain hours of the day—below 75 h.p. The result is that if his daily average of actual horse-power consumed falls below 75, then he is paying just that much more than $20 per annum per h.p., to say nothing of the additional pay for every h.p. over 75.

Experience teaches that not one manufacturer in a hundred actually uses the amount of horse-power produced or contracted for. A hundred h.p. may be necessary to take care of his peak load, but this peak requirement is usually of very short duration—more commonly only momentary—and it is, as a rule, safe to say that his average load line for each day of ten hours will not average over 60 per cent. of his peak. Taking the above example, this would figure out: 60 per cent. of 90 h.p. equals 54 h.p., and 54 h.p. divided into $1,500 equals $27.75 per h.p., instead of $20, or 38 3-4 per cent. more than he thinks he is getting it for.

If the Hydro-Electric Commission could recommend an actual charge of $20 per annum per h.p. actually delivered, and sell it through a meter, with no "stand-bys" or "minimum,'—except a charge for meter rental—then it would figure out as follows:—

Three hundred days of ten hours each equal 3,000 hours, and $20 divided by 3,000 hours equals sixty-seven one-hundredths of a cent per h.p. hour, or, if expressed electrically, about eighty-eight one-hundredths of a cent per kilowatt hour. Obviously, however, this could not be done. Capital would not go into such an enterprise, and it must be equally obvious, therefore, that "$20 per annum per h.p." is practically only a figure of speech. But a public power company must put in an enormously expensive equipment, with heavy overhead charges, and, consequently, must be assured of a certain minimum revenue. They cannot take any risks. Therefore, the consumer must take it—and agree to carry it for a term of years. Assuming, then, that "$20 per annum per h.p." really means $25 to $30 per annum per h.p.—or say an average of $27.50—the question then arises, can the manufacturer do any better? Can he make his own power for any less? The answer is, he can. He can make 3,000 h.p. hours, including all operating costs, for $12, and, even after adding interest and depreciation, his cost per annum per actual h.p. consumed will not exceed $17 to $18, and for every h.p. which he does not consume or produce his cost is less in proportion. Furthermore, he is free and independent—which, in themselves, are elements of importance and value. All power and lighting companies must protect themselves against damage suits. They, therefore, must make the purchaser agree that "for causes beyond its control" the power company is not liable. If ice jams the water wheels at the source of power, the purchaser must take the consequences. If, by storm or "other acts of God," the transmission lines go down, the purchaser must wait, idle, if need be, until repairs are effected.

In fact, when any individual does business with any public utility company he forthwith is required to absolve the company from every conceivable consequential damage, and one need only refer to the "fine point" in such agreements—from telegraph blanks to insurance policies—to be reminded of the utter helplessness of "the party of the second part."

If one hundred manufacturers were asked "Would you not prefer to make your own power, if you could do it as cheaply as you could buy it from the outside?" they would, to a man, say "Yes." But the trouble is they do not know that they themselves can do it—and even at less. They look even upon $27.50 as very cheap power.

If the manufacturers of Ontario give first consideration to their own interest they will first find an answer to the question "How cheaply can I produce my own power?" before going any further, and the writer stands quite ready to furnish reliable proof that it can be done, easily, at an overall cost of $17 to $18.

In England, where fuel is exceedingly high—25 to 30 and sometimes 35 shillings per ton for anthracite coal—the suction gas engine is invariably given the preference, not only over steam engines, but over outside current, even when the latter can be purchased as low as two and one-half cents per kilowatt hour. There are hundreds of suction gas engine plants in England, even as small sizes as 20 h.p., which are producing a kw. hour, with all costs added, at about one cent. The Hornsby-Stockport gas engine has demonstrated remarkable economy in fuel consumption, giving a brake horse-power on the shaft of the engine for three-quarters of a pound of anthracite coal.

With anthracite coal in Canada at $4.50 per ton, this is equivalent to a fuel cost per b.h.p. hour of less than seventeen one-hundredths of a cent, or, for a ten hour day, of one and seven-tenths cents, or, for 300 days, of $5.10.

Recently a prize of one thousand pounds was offered by the British War Office for the best engine (small unit) suitable for military purposes—either steam, gas, oil or any other kind of fuel. This prize was also won by the Hornsby engine, and a bonus of two hundred pounds was also won for having exceeded the required efficiency by 45 per cent.

It must be evident, therefore, that power can be produced at very much lower cost than it can be purchased for from outside sources.

Liquid Fuels For The Gas Engine*

By Charles Edward Lucke.

Liquid fuels available for use in exploding engines —that is to say, for vaporizing and mixing with air in a properly constructed mechanism—have quite different characteristics. With respect to their source they can be divided into two classes: The first, crude petroleum and its distillates, which have some characteristics in common; and the second, alcohol, which is quite different from any of the petroleum distillates in all of its characteristics. When crude oil is boiled or refined, vapors are evolved which may be condensed. These condensed vapors are called "distillates."

In a refinery the temperature of the vapor coming off is measured and the distillates collected either between two limits of temperature or two densities, for as the boiling proceeds the temperature of the liquid and vapor continually rises and the density of the distillates also continuously rises. The first distillates are light and the last heavy. The last distillates constitute lubricating oils; the first and intermediate distillates constitute gasolene, napthas, kerosene, etc., available for revaporization for use in exploding engines. These distillates are not simple fuels, but are mixtures of different chemical composition, always containing carbon and hydrogen. They comprise all the material that goes over in the boiling between two limiting densities, the mixture having a sort of average density.

There is not a good agreement between the character of the materials designated gasolene, kerosene, etc., and the temperature of distillation and densities employed in different places, so that such names seem to have more commercial significance than scientific value. Table I shows one set of values that is probably as good as any densities reported, they being compared with water and given in Baume's hydrometer scale at 59 degrees F.

Gasolene is far different from a simple substance which would have a fixed boiling point, and therefore theoretical calculations on the heat of combustion, air necessary, and conditions for vaporizing or carbureting air are of little value. On the other hand, alcohol is a simple substance, or, more properly, there are many alcohols each of which is a simple substance; but they are not so used in an engine. The alcohol which it is proposed to manufacture for industrial uses under the recent law is ethyl alcohol having a definite chemical composition C_2H_5OH. This material is seldom, if ever, obtained pure, it being generally diluted with water and containing other alcohols when used for engines. The alcohol present is in an impure condition. Thus 90 per cent. alcohol means alcohol and water mixed so that there is 90 per cent. of alcohol by volume present. The density of the alcohol depends upon the amount of water present, of course, and upon the temperature as well, as it varies considerably with temperature. The Smithsonian tables of the density of alcohol with temperature are given herewith in part with a computation by which the percentage of alcohol by weight or volume can be determined when the density and temperature of the mixture are known:

For the range of percentage contained in Table II, the correction for temperatures different from 60 degrees F. should be made as follows:

If the density is measured at a temperature above 60 degrees, 0.0005 should be added to the measured density for each degree which the temperature at the time of the measurment differs from 60 degrees. When the temperature at the time of measurement is below 60 degrees, the same correction should be subtracted from the measured density. The corrected density should then be used in the table for finding the true percentage of alcohol.

TABLE I. DEFINITION OF PETROLEUM DISTILLATES.

Name.	Boiling Point—Deg. F.	Specific Gravity.	Density—Degrees Baume
Petroleum Ether	104—158	0.650—0.660	85—80
Gasoline	158—176	0.660—0.670	80—78
Naphtha C	176—212	0.670—0.707	78—68
Naphtha B	212—248	0.707—0.722	68—64
Naphtha A	248—302	0.722—0.737	64—60
Kerosene	302—572	0.753—0.864	56—32
Lubricating Oil	572 up.	0.864—0.960	32—15

The percentage of alcohol found in a sample is always likely to be greater when determined chemically than when determined by the hydrometer, because the presence of impurities in the way of solids dissolved in the alcohol or as any of the series of higher alcohols tends to make the specific gravity of the sample greater, and hence make it indicate too low a percentage of alcohol.

Although pure alcohol is, as was shown above, a simple chemical substance, and so permits of computations on the heat of combustion, the amount of air necessary for its proper combustion, the amount of heat to vaporize it, the proper air temperature for carburetion, or anything else that might be desired in connection with its performance in an engine, yet in actual engines this pure alcohol is never used. The revenue laws permit the tax-free use of only denatured alcohol, that is to say, a fuel consisting principally of ethyl alcohol, but with various substances added to it to render it unfit for drinking, and which may have little or much effect upon its value as an engine fuel.

In the United States the substances to be added are at least 10 parts of methyl alcohol to 100 parts of 90 per cent. ethyl alcohol by volume, in addition to one-half of 1 part benzine. Even this small addition makes it difficult, if not impossible, to make accurate calculations concerning what the mixed fuel will do in an engine. In Europe, during all these years of development, many hundreds of tests have been made with all sorts and conditions of fuel mixtures, some of them with alcohol which is free of denaturants, some with denatured alcohol, and some with purely experimental mixtures. Every different fuel element and every different fuel mixture will have characteristics when used in an engine, so that in comparing these engine results it is clearly necessary to have some knowledge of the nature of the fuel mixtures used.

* From a bulletin of the U.S. Department of agriculture.

Heat of Combustion.

One of the most important things to know concerning a fuel is the amount of heat it will liberate when burned, or its heat combustion, for by this the weight of fuel burned per horse-power hour can be transformed to thermal efficiency. This is determined practically by burning the fuel in a very accurate instrument called a calorimeter, so arranged that all of the heat will warm up water so that the amount of heat liberated may be determined by the temperature rise of this water. The heat of combustion thus determined for the gasolene which we used in our tests, was found to be 21,100 B.T.U. per pound of gasolene. It is known that the heat of combustion of gasolene is not very different from that for the crude oil or any of the distillates, and in common practice it is usual to take this value as 20,000 B.T.U. per pound of oil when other more accurate information is lacking. The alcohol which we used in our tests, 94 per cent. by volume, had a heat of combustion as determined by the calorimeter of 11,900 B.T.U. per pound, which is just a little more than half of the gasolene.

The heat of combustion as determined by the calorimeter does not fairly represent the amount of the heat set free in the engine cylinder, because when the fuel contains any hydrogen—and all of these fuels do—that hydrogen will form steam on combustion, which will condense to water and add its latent heat of condensation to the true heat of combustion. The heat of combustion obtained when the products are condensed, as in the calorimeter, is termed the high value; that obtained by subtracting from this high value the latent heat of condensation of such water as is formed is termed the low value

TABLE II. SMITHSONIAN TABLE OF SPECIFIC GRAVITIES OF ETHYL ALCOHOL.

Specific Gravity at 60° F. Compared with Water at 60° F.	Percentage of Alcohol.		Specific Gravity at 60° F. Compared with Water at 60° F.	Percentage of Alcohol.	
	By Weight.	By Volume.		By Weight.	By Volume.
0.834	85.8	90.0	0.822	90.4	93.4
0.833	86.2	90.3	0.821	90.8	93.7
0.832	86.6	90.6	0.820	91.1	94.0
0.831	87.0	90.9	0.819	91.5	94.2
0.830	87.4	91.2	0.818	91.9	94.5
0.829	87.7	91.5	0.817	92.2	94.8
0.828	88.1	91.8	0.816	92.6	95.0
0.827	88.5	92.1	0.815	93.0	95.3
0.826	88.9	92.3	0.814	93.3	95.5
0.825	89.3	92.6	0.813	93.7	95.8
0.824	89.6	92.9	0.812	94.0	96.0
0.823	90.0	93.2	.....		....

In reporting a calorific power for any of the oils or alcohol it must be clearly known whether the value is high or low, as they are appreciably different. Especially important is this when it is known that only the low value is set free in exploding engines, because the exhaust gases are always hot enough to prevent condensation of steam. These fuels contain carbon and hydrogen in various proportions and the alcohol contains, in addition, some oxygen.

Knowing the heat of combustion and the elements, it would seem possible to calculate the heat of combustion of compounds of these elements, and various formulas have been proposed for this purpose which are used in some cases by European experimenters in reporting their results. It is interesting to note in this connection that the heat of combustion determined by such a formula from its ultimate analysis seldom gives values that agree with the calorimeter. This is because of certain assumptions made on the molecular constitution of the elements shown to be present. Thus, when hydrogen and oxygen are present in water proportions it is assumed that the group can not give any further heat of combustion, and further, that there is no heat absorbed to separate the group from the other molecules as heat of dissociation. This assumption vitiates the results, but for any given fuels a constant can be determined in the nature of a correction to the calculation to make the results agree with the calorimeter, which it is possible to apply with fair accuracy to similar fuels.

Air Necessary for Combustion.

When a fuel has a definite chemical composition, the air necessary for combustion can be exactly determined; otherwise it must be an assumption. This calculation can be made, therefore, for ethyl alcohol or for methyl alcohol, but it is difficult, if not impossible, for a denatured alcohol or for gasolene or kerosene.

In an actual engine the amount of air is proportioned to the amount of vapor, not by any exact measurement of either, but by experimental trials, to secure either the best results in maximum power or minimum fuel consumption, but in this case the experimenter has no knowledge of the fuel supplied but unburned. As a check upon this adjustment, it has been the practice in the European tests, especially those of Sorel, to analyze the exhaust gases with a view to determining the amount of air supplied by the chemical composition of the exhaust. An engineer operating the engine, however, has no means for determining results such as this, and, in fact, cares very little just what quantity of air is being supplied so long as it is clear that no fuel is passing away unburned or so long as the engine is doing the proper amount of work with the minimum of fuel.

MUNICIPAL ELECTRICIANS.

The twelfth annual convention of the International Association of Municipal Electricians will be held at Norfolk, Va., August 7th, 8th and 9th, 1907, in the City Hall. Norfolk has been selected as the meeting place not only for its position geographically but also for the reason of the holding of the Jamestown Exposition, giving the delegates a chance to see the very latest developments of the Electrical Art, which will be on exhibition at that time. The papers selected for this meeting are of interest to all Municipal Electricians: "Electrical Inspections and Records"; "Modern Application of Storage Batteries"; "The Value of Volt and Ammeter Tests for Insulation"; "A Modern Fire Alarm Central Office"; "Operation of a Municipal Electric Light Plant".

STRENGTH OF INSULATOR PINS.

At the request of certain consumers, the Forest Service of the United States Department of Agriculture recently made tests on fifty-three insulator pins of rock elm, live oak and black locust. The tests were made at the timber-testing station of the Forest Service at Purdue University, Lafayette, Ind. The results indicate the relative strength of the pins tested, although they depend upon too small a number of tests to show in an authoritative way the relative value of these woods.

The pins were of standard size, one and one-quarter inches by eight inches. The oak pins were from one-eighth to one-quarter inch shorter than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about one-half inch shorter than in the cases of the other two species.

In testing the pins an iron block was clamped to the stationary upper head of a small screw-testing machine. The pins were inserted to a tight fit in a hole in this iron block, and projected horizontally over the pulling head of the machine. The glass insulator was unable to bear the strain of the wire so an iron model of the ordinary glass insulator was screwed on the pin and connected by means of a heavy wire to the pulling head of the machine. When a strain was put on this wire, the pin acted as a beam fixed at one end and loaded at the other, which is practically the condition met with in practice. The breaking moment (maximum load in pounds times the lever arm in inches) was taken as a measure of the strength of the pins.

The tests showed that the breaking strength of the black locust pins was roughly 4,000 in.-lbs., of the live oak pin about 3,000 in.-lbs., and 2,500 in.-lbs. for the rock elm pins.

The locust and elm pins failed mostly by splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by shearing horizontally. The oak pins nearly all failed by tension at the shoulder.

LIGHTNING EFFECTS ON TELEPHONE POLES.

In the "National Telephone Journal" for February there are some interesting particulars of lightning upon the outside equipment of the National Telephone Company, which were observed in Nottingham last summer. The following is a noteworthy occurrence: During a heavy thunderstorm last summer one of the company's poles, just erected, but carrying no wires, was struck by lightning. The earth wire, with the exception of about eight inches coiled round the pole near the top, had completely disappeared, and no trace of the staples which originally held the wire could be found. At the point where the staples had been fixed the pole was punctured as if by climbers, but the holes were bigger than those ordinarily made by climbers. A hole two feet deep was made in the ground where the earth wire entered. The hedge on the roadside, which was close to the pole, was badly scorched. The nails holding the roof on the pole were withdrawn to about half their length, but the roof was not damaged. The pole itself did not appear to be damaged otherwise than by the apparently sudden fusing of the staples. Three holes about one foot deep and one foot in diameter were made in the ground on the opposite side of the ordinary roadway of the pole. Another incident occurred during the building of the same route. About two miles of wire had been erected on the poles, and left "dead" on the insulators at one end. At the other end the wires came down from the pole in coils, which were hung on a wooden fence. When the men went to pick up the coils to proceed with the works, they received shocks similar to those from a Leyden jar in discharge. The weather was cloudy and thundery, although no storm was taking place at the time.

PUBLICATIONS.

The Ground Anchor Company, Limited, of Montreal, describe the "Auld" ground anchor in a booklet which they have recently published for distribution. This anchor is guaranteed to hold in any kind of soil.

The Co-operative Electrical Development Company are offering $250 in prizes for the composition of the "Electrical Co-operators' Creed." This creed should give the best possible brief expression to the idea and purpose of the Co-operative Electrical Development Association.

The Chase-Shawmut Company, of Newburyport, Mass., have just received from the hands of the printers circulars and miniature bulletins covering some of their special lines, such as Shawmut ground connection clamps, extended terminal fuses, pocket test lamps, Boston cable clips, red E solder paste, and porcelain cut-out blocks.

The Canadian General Electric Company are selling agents for the Tuerk alternating current ceiling fans, manufactured by the Hunter Fan & Motor Company, Fulton, N.Y. These fans are described in a very artistic booklet, which may be obtained from the advertising department of the Canadian General Electric Company.

The special tariff edition of the Canadian Manufacturer is one of which the publishers may justly feel proud. It consists of 224 pages, enclosed in an artistic cover, and contains complete reproductions of the tariffs of Canada, the United States, Great Britain, Newfoundland and Japan. These tariffs are arranged in most convenient form, and will doubtless be found of great assistance to Canadian business men.

The Robb Engineering Company, Limited, of Amherst, N.S., have recently issued two very complete catalogues, one devoted to Robb-Armstrong engines, the other to steam boilers. It is interesting to note that the original design of the Robb-Armstrong engine was made by E. J. Armstrong, M.E., in 1891. The Robb Engineering Company recently introduced the Robb-Armstrong Corliss engine, both horizontal and vertical, and are now producing still another line of engines of the vertical, high speed enclosed type for self-contained electric lighting sets and other purposes requiring a compact, self-contained engine.

SPARKS.

The Rogers Electric Company, Limited, of Toronto, has been incorporated, with a capital of $50,000, to manufacture and deal in electrical supplies. The directors include Messrs. Joseph Rogers, Clarence Reid and Gordon Russell.

Tenders are now being invited for electric lighting of the City of Hamilton. Negotiations for a renewal of the present contract have been under way for some time, but the Hamilton Cataract Power, Light & Traction Company have not yet submitted a proposition acceptable to the city.

The Moose Jaw Electric Company is a new concern that has recently come into existence in the city of that name, the office and showrooms being located at 18 High street west. Mr. Jas. E. Ashworth is manager in charge, and Mr. W. G. Fry secretary-treasurer. The new company carry full lines of electrical fixtures of all descriptions. They are, at the time of writing, engaged on the installation of the electrical apparatus of the New Lion Methodist Church at Moose Jaw.

PERSONAL.

The death occurred in Toronto on May 24th of Mr. Bert Kent, of the Kent Electric Company, the result of an attack of typhoid fever. Mr. Kent, who was in his 31st year, had lived in Toronto all his life, and had been connected with the electrical business since his boyhood days.

In the May number of The Electrical News it was stated that Mr. P. E. Hart had accepted the position of electrical engineer of the Town of Kenora, Ont. This position was offered to Mr. Hart, but he declined it, preferring to remain with Allis-Chalmers-Bullock, Limited.

Mr. John Munroe, foreman of linemen for the Trenton Electric & Water Company, met with almost a fatal accident on May 20th. While making repairs on the top of a high electric pole he came in contact with a live wire. He was rendered unconscious and fell a distance of thirty feet, sustaining serious injuries.

SPARKS.

The ratepayers of Morden, Man., have voted in favor of establishing a municipal electric light plant.

Mr. Robert Agnew, of Meaford, Ont., will construct a telephone line at Walter's Falls.

Woodman Bros., electrical contractors, Hamilton, have removed to more commodious offices, corner of Main and Catharine street.

The Town Council of East Toronto have accepted the tender of the Canadian General Electric Company for another generator for the power house.

At the annual meeting of the American Institute of Electrical Engineers, held in New York last month, the following officers were elected:—President, H. G. Stott; vice-presidents, L. A. Ferguson, J. G. White and C. L. Elgin; managers, B. G. Lamme, H. W. Buck, P. H. Thomas, and Morgan Brooks; secretary, Ralph W. Pope; treasurer, G. A. Hamilton. The report of the secretary showed 4,521 members enrolled.

SPARKS.

Mr. K. L. Aitken, consulting engineer, who was retained some time ago by the Waterworks Department of the City of Hamilton, and the Hamilton Gas Light Company, to report upon electrolytic damage to their piping systems, recently spent a week in Hamilton on this work. No statement has been given out as yet (as the report will require another month to complete) other than general information to the effect that a large flow of current from the street railway tracks to the two piping systems was found. This matter of electrolytic damage is a serious one, and the results of the Hamilton test are being awaited with interest.

The British Columbia Telephone Company, through their office at Nelson, B.C., have made an offer to the ranchers on the north side of the west arm of Kootenay Lake, to supply telephone service at the rate of 50 cents per month to each subscriber, on condition that the subscribers erect and maintain their own pole line. The company's exchange at Greenwood, B.C., has been entirely rebuilt, new apparatus being installed, which includes a new switchboard, new poles, wires and cables. It is probable that a new switchboard will soon be installed at Nelson, B.C., as the capacity of the present board in the exchange there has been reached.

BOOKS

Lecture Notes on the Theory of Electrical Measurements, by W. A. Anthony, Cloth $1.00.
A History of Electricity, by P. Benjamin, Cloth $3.00.
Elementary Treatise on Electric Batteries, by Niandelt & Fishbach, Cloth $2.50.
Text Book of Electrical Machinery, by Ryan, Norris & Hoxie, Cloth $2.50.
Electrical Engineering, by E. Rosenberg, Cloth $2.00.
The Testing of Continuous Current Machines, by C. Kinzbrunner, Cloth $2.00.

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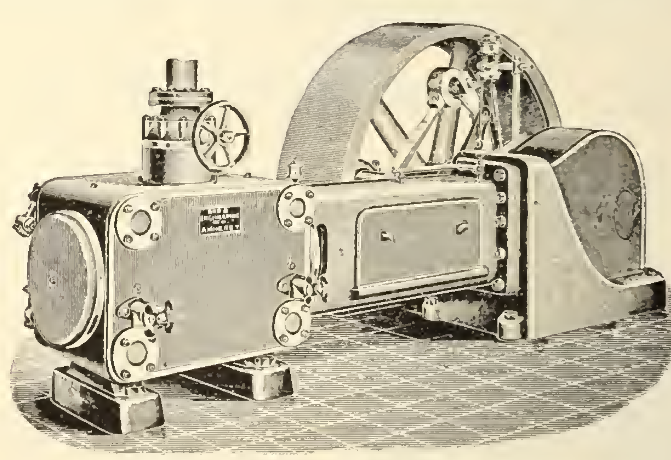

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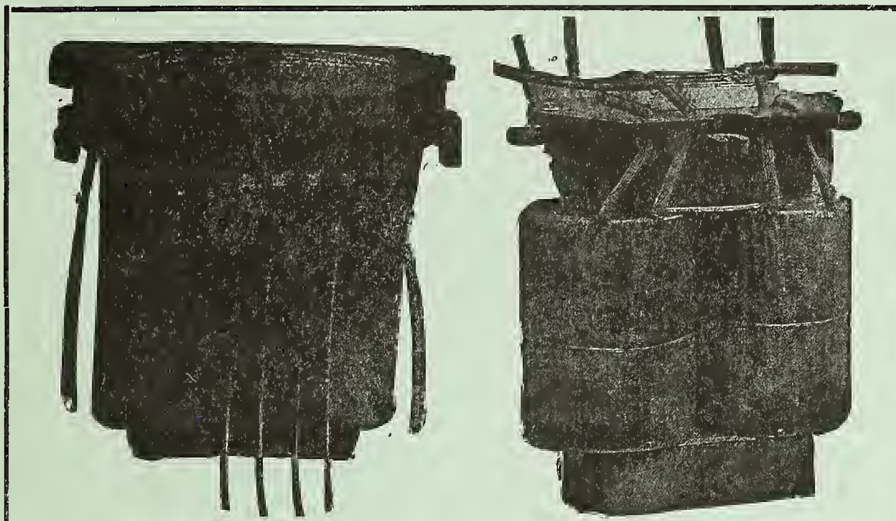

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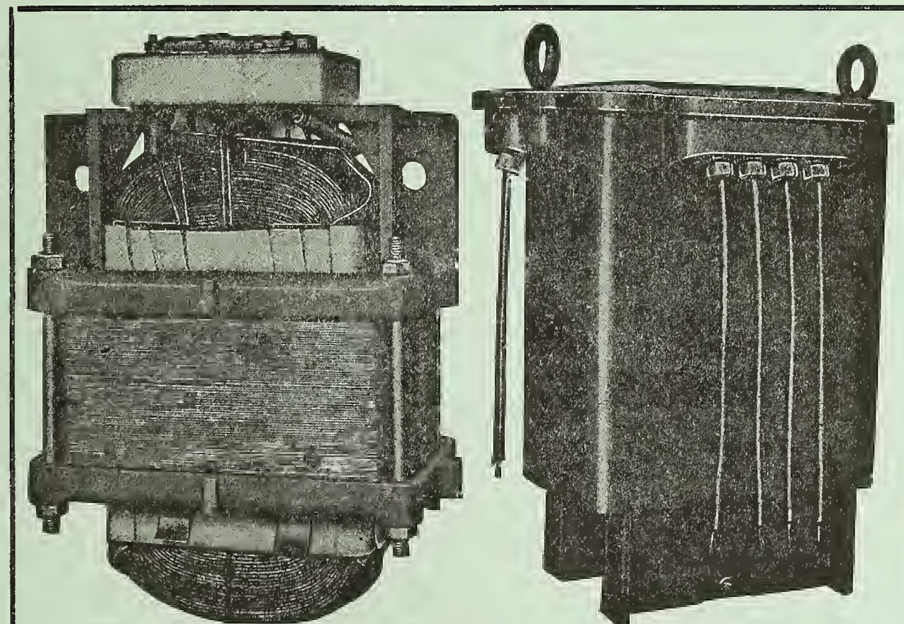

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MOONLIGHT SCHEDULE FOR AUGUST

Date.	Light.	Date.	Extinguish.	No. of Hours.
Aug. 1	7 50	Aug. 2	1 30	5 40
2	7 50	3	2 00	6 10
3	7 50	4	2 30	6 40
4	7 40	5	3 15	7 35
5	7 40	6	4 00	8 20
6	7 40	7	4 10	8 30
7	7 40	8	4 10	8 30
8	7 40	9	4 10	8 30
9	7 40	10	4 20	8 40
10	7 30	11	4 .0	8 50
11	7 30	12	4 20	8 50
12	7 30	13	4 20	8 50
13	7 30	14	4 20	8 50
14	7 30	15	4 20	8 50
15	7 30	16	4 20	8 50
16	7 30	17	4 20	8 50
17	10 20	18	4 20	6 00
18	11 10	19	4 20	5 10
20	0 10	20	4 30	4 20
21	1 15	21	4 30	3 15
22	2 30	22	4 30	2 00
23	No Light	23	No Light	
24	7 20	24	9 20	2 00
25	7 10	25	10 00	2 50
26	7 10	26	10 30	3 20
27	7 10	27	11 00	3 50
28	7 10	28	11 30	4 20
29	7 10	30	0 00	4 50
30	7 10	31	0 30	5 20
31	7 10	Sept. 1	1 10	6 00
			Total............	183 40

The City of Ottawa assessed the Ottawa Electric Railway Company on a $40,000 storage battery. The company declined to pay, alleging that their agreement with the city exempted it. At the trial in Ottawa Mr. Justice Teetzel decided against the company, but the Court of Appeal handed out judgment in their favor, so that hereafter the battery will be exempt.

Please mention the CANADIAN ELECTRICAL NEWS when corresponding with advertisers.

CLASSIFIED INDEX OF ADVERTISERS.

SPARKS.

Mr. K. L. Aitken, of Toronto, recently finished making his electrolysis tests at Hamilton. He found many places where there is a large flow of current in the pipes. Advice will be given Mr. Barrow as to what precautions are to be taken in connection with the matter.

A water fall of 1,230 feet on the Mokelumne river, in Central California, is to be used by the General Electric Power Company, of California, for the development of electrical power on an enormous scale. This immense fall will develop 69,000 horse power, which will be transmitted to all the towns and cities of Central California, including the city of San Francisco.

The Council of Revelstoke, B.C., contemplate installing a producer gas plant for the generation of electricity to supplement their present hydro-electric plant, for use principally during the winter months. Particulars may be obtained from the Mayor.

WINNIPEG'S POWER DEVELOPMENT.

The City of Winnipeg is asking for tenders up to Tuesday, September 3rd, for the construction and equipment of the hydro-electric power plant at Point du Bois, also for a transmission line from Point du Bois to Winnipeg and a transformer station in Winnipeg. Separate tenders will be received for the following:

(3) Telephone system.
(4) General works at Point du Bois.
(5) 4,000 horse-power turbines (five).
(6) 450 horse-power turbines (two).
(7) 3,000 kilowatt generators (five).
(8) 250 kilowatt generators (two).
(9) Induction motor (one).
(10) Step up transformers (five).
(11) Generating station, switching and accessory apparatus.
(12) Generating station, light, heat and power systems.
(13) Generating station, oil and air systems.
(14) Erection of transmission system (75 miles).
(15) Steel towers.
(16) High tension insulators.
(17) Electric transmission cable.
(18) Terminal station.
(19) Step down transformers (five).
(20) Terminal station, switching and accessory apparatus.
(21) Terminal station, light, heat and power systems.
(22) Terminal station, oil and air systems.
(24) Testing transformers and apparatus.
(25) Electric travelling cranes (three).
(26) Turbine governors (seven).
(27) Auxiliary apparatus.
(28) Repair shops.

Mr. R. T. Grocott, of the firm of Gaskell & Grocott, Whitehall Works, Longport, Staffs, England, was in Montreal last month. He was looking over the ground with the idea of establishing an agency. His firm are specialists in high tension insulators.

PUBLICATIONS.

The Canadian General Electric Company call attention in a recent folder to the Diehl electric fans. Every fan is of the swivel trunnion type and may be adjusted for use as desk or bracket without requiring extra parts.

Electrical Engineering, London, England, recently published an illustrated description of the works of Evershed & Vignoles, Limited, manufacturers of bridge meggers, ammeters, etc. The description has been printed in pamphlet form for distribution by the company.

The Canadian Westinghouse Company's 1907 fan catalogue is a very artistic production. Illustrated therein are their desk and bracket fans, alternating current desk and walls fans, ceiling and floor column fans, etc., also a complete line of small power motors for direct and alternating current.

The Macmillan Company of Canada, 27 Richmond street west, Toronto, have favored us with a copy of a valuable book entitled "Armature Construction," the authors being H. M. Hobart, B.Sc., and A. G. Ellis. It contains 420 illustrations, including numerous colored diagrams. The subject of armature construction has been considered from the constructional and practical standpoint rather than from the designing and calculating standpoint. For instance, in the chapters dealing with windings, the subject is dealt with in the aspect of the practical possibilities of the windings, the electro-magnetic properties not being considered to such an extent as they would be in a more general or more theoretical treatise. The retail price of the book is $4.50.

PERSONAL.

Mr. R. S. Cotton, of Gananoque, Ont., has gone to Vancouver, where he will be employed on the construction staff of the Canadian General Electric Company.

Mr. C. North has recently been appointed manager of the electrical department of Lawrence & Company, Limited, Revelstoke, B.C.

SPARKS.

Marconi wireless telegraph apparatus is being installed on the steamer Camosun, which will be the first vessel on the Pacific coast of Canada to be equipped with wireless apparatus.

Somerville, Limited, Toronto, Ont., have recently ordered from the Robb Engineering Company a 200 horse-power 16 inch x 30 inch Robb-Armstrong Corliss engine, arranged for direct connection to an electric generator.

The Chambers Eelectric Company, Truro, N.S., have ordered from the Robb Engineering Company one 10 inch and 16 inch x 18 inch Robb-Armstrong vertical cross compound engine, arranged for direct connection to a 75 kw. generator.

Three tenders were received by the Hamilton Board of Works for street lighting, one of these being from the Hydro-Electric Power Commission. The committee decided not to open any tenders for another month and to get prices on gas lighting also.

An electric signal has been patented by E. Lionais and W. T. Sutton, of Montreal. The invention has reference to electric signals, particularly to ringing one or more electric bells from a distance. It also relates to a system in which a relay is used for controlling a bell in which a single battery is employed for operating the bell and energizing the relay.

P. Burns & Company, of Vancouver, are establishing an elaborate four-panel switchboard at their new abattoir, which is nearing completion. The board will be used for receiving and distributing current for light and power purposes. It is equipped with the latest type of instruments for measuring and recording, and will be one of the most complete switchboards used for this purpose in the West. The board was purchased from the Westinghouse Company.

The concrete work for the new power house at Stave Lake, B.C., for the Stave Lake Power Company, is well under way. When fully completed this company expects to have 30,000 horse-power of electrical energy to supply for commercial purposes in and around Vancouver, B.C. There will be a 40 mile high transmission line from Stave Falls to New Westminster and Vancouver. The president of this company is Mr. John Hendry, of Vancouver; the secretary-treasurer and general manager, Mr. Wm. McNeil. Mr. Wm. Kennedy, of Montreal, is chief hydraulic engineer, and Mr. W. R. Bonnycastle electrical engineer in charge. The offices of the Stave Lake Power Company are in the Williams' Block, Vancouver.

Vancouver capitalists are looking into the posibilities of developing an immense water power on the Cheakamus river, at the head of Howe Sound. Messrs. Hermon & Burwell, the eminent hydraulic engineers, have made a report on the power. Briefly, three development schemes are outlind in this report, one by means of which 100,000 horse-power can be secured under a head of 565 feet; another, which will give 75,000 horse-power at a head of 400 feet, and a third whereby 20,000 horse-power at a head of 115 feet feet can be secured. The report shows that the power plant will be located 16 miles from tide-water and two routes are open for the transmission line to Vancouver, one along the eastern shore of Howe Sound and northern shore of the English Bay and the Inlet to the Second Narrows, the other via the valley of Seymour Creek to the Second Narrows. The distance is 61 and 47 miles respectively. It is proposed to transmit at 50,000 volts. The promoters of the scheme are the British Columbia Power & Electric Company, among the shareholders being Messrs. D. G. Marshall, J. E. Miller, F. W. Tiffin, Frank Springer, R. H. Bryce and H. G. Bissett.

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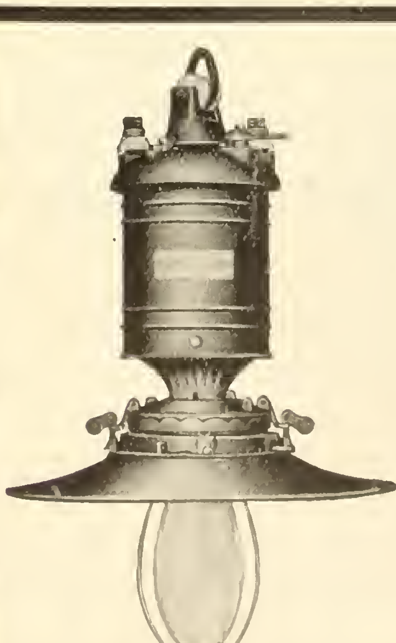

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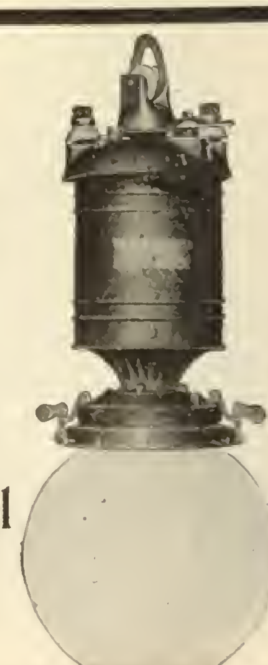

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XVII. JULY, 1907 No. 7.

Power Development of the Georgian Bay Power Company

H. VON SCHON, in The Engineering Magazine.

The hydro-electric development of the Georgian Bay Power Company, Limited, of Toronto, is located in the Georgian Bay district of Ontario, its subject being the picturesque Eugenia Falls, which are situated on the Beaver river, emptying into Georgian Bay, Lake Huron. The contributing drainage area is 200 square miles, the available flow 80 cubic second feet, and the effective head 400 feet.

The development programme is of the distant diversion plan, the river being closed by a spillway and reservoir dam at the village of Eugenia, whence the water is conducted by a steel pipe pressure line some 3,500 feet long to the power house on the river; the plan herewith outlines this programme. This distinctive features of this development are the dam, being of the Ambursen concrete-steel shell type, reservoir concrete-steel bulkheads, and the passage of the pressure line in part through a tunnel.

The spillway structure is representative of the latest development in dam designs. While the solid masonry or concrete dam (until recently considered the only safe and permanent device to impound flowing water) resists the pressures by its weight, this latter design utilizes the water pressure to maintain its position, through the adoption of a triangular form of such shape that the weight of water upon it equals the horizontal pressure component; this principle could be adapted to the solid type but would require such a large mass that its cost would be prohibitory, while this structure consists of a shell of

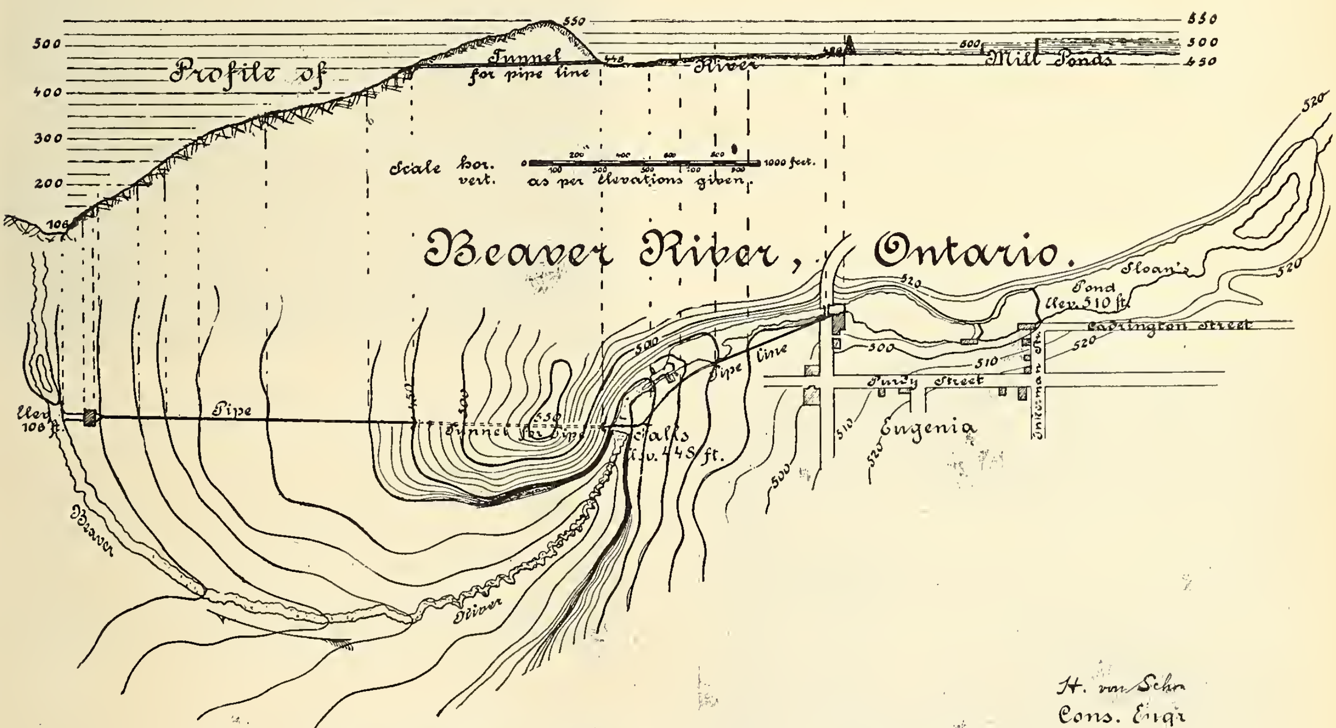


FIG. I MAP SHOWING GENERAL TOPOGRAPHY AND FALL, EUGENIA POWER INSTALLATION.

concrete-steel in which the necessary strength and rigidity is secured by a very small fraction of the quantity of material needed in the solid structure. The advantages of such a type are manifold; its comparatively light weight requires less costly foundation and diminishes the danger of settlement and consequent cracks; the interior steel bar net binds the whole into a homogeneous mass, imparting to it a greater resistance to the influence of fluctuating temperatures; danger from underwashing is minimized, since its stability, being independent of inherent weight, is not reduced by upward hydrostatic pres-

sures, as is the case with solid dams; the flow during construction can be more readily and economically controlled, and the structure can be built in considerably less time than the solid dam; and, finally, the interior is accessible, can be inspected, repaired, utilized for arrangement of waste flumes and flash-boards, and last, but not least, for the housing of the power equipment. The prospective construction of such a spillway is illustrated by accompany views.

The Eugenia spillway is 80 feet long and 40 feet

FIG. 2.—SPILLWAY UNDER CONSTRUCTION ON THE JUNIATA RIVER, SHOWING THE REINFORCED-CONCRETE BUTTRESSES. THIS IS IDENTICAL IN TYPE WITH THE EUGENIA FALLS INSTALLATION.
By courtesy of the Ambursen Hydraulic Construction Co.

high and consists of seven transverse concrete-steel partitions, or buttresses, of triangular shape, the up-stream ends on slope of one in one, the down-stream one half in one; these are anchored to a rock ledge, 10 feet centres and 22, 18 and 12 inches thick from bottom up. The up-stream ends are covered by the concrete-steel deck, 24 inches at bottom, 12 at top, the

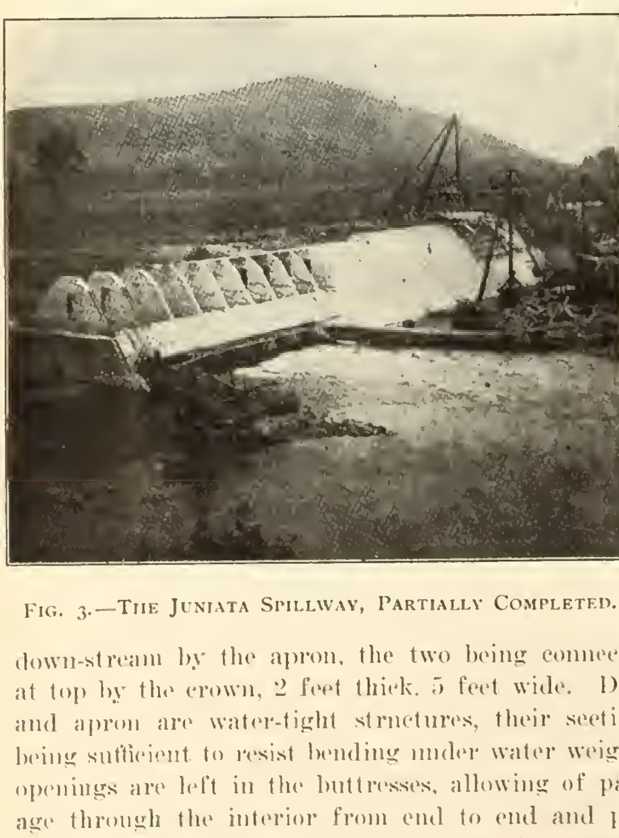


FIG. 3.—THE JUNIATA SPILLWAY, PARTIALLY COMPLETED.

down-stream by the apron, the two being connected at top by the crown, 2 feet thick, 5 feet wide. Deck and apron are water-tight structures, their sections being sufficient to resist bending under water weight; openings are left in the buttresses, allowing of passage through the interior from end to end and preventing accumulation of lateral hydrostatic pressures against them; air vents are placed through the apron under the crown, creating free circulation and thus avoiding formation of a vacuum beneath the over-falling sheet of water. The spillway is closed by concrete-steel buttresses, entrance to the interior being obtained through doors opening on the down-stream side. The complete closing of the river valley from bank to bank, some 1,000 feet in width, is accomplished by reservoir bulkheads, being of same design as the above described spillway minus the apron and rising six feet above the spillway crest, being safely above the highest probable pond level. These, as well as the spillway type, represent a departure from past reservoir structure practice, which had heretofore almost always adopted earth embankments with some kind of an interior core. The concrete-steel bulkheads are more economical in cost and absolutely permanent.

Water passes into a well on the south side of the spillway, to which is connected the 54-inch steel pipe conducting it to the power house three-quarters of a mile distant; on its way it crosses the river just above the falls and, curving northerly, pierces a bluff 150 feet high. The tunnel is 10 by 11 feet, lined with cedar which is obtained at the site; the pipe rests on timber frames. Emerging from the tunnel the pipe

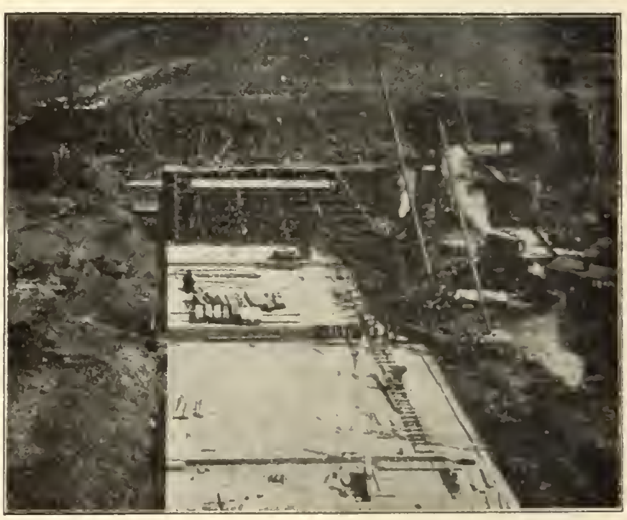


FIG. 4.—FLOOR OF THE JUNIATA SPILLWAY, IDENTICAL IN TYPE WITH THE EUGENIA FALLS PLANT.

is reduced to 48 inches for 1,000 feet, passing down the hillside at a 10 per cent. grade, and then to 36 inches, taking its final plunge down a steep incline. Concrete anchorages are distributed along the pipe line location, and its terminal consists of a concrete bulkhead where it is separated into two 24 inch feeder pipes, each leading to a separate turbine in the power station.

The power house is of concrete and steel frame, 40 by 50 feet; the tail race is a concrete-steel flume.

The equipment consists of two Swiss wheels of the volute type; generators are coupled to the turbine shafts. The highly refined turbine installation presents many interesting features of controlling the water and governing the output. The capacity of the plant is 2,500 electrical horse-power, all of which is transmitted at a pressure of 13,000 volts on the single current three phase line, to Owen Sound, Ont., 38 miles distant, where it is sold to cement plants, industrial shops, shipyards, and for lighting, the rates being from $35 per hourse-power up.—Engineering Magazine, New York.

Electric Distribution Systems

In a paper read before the Convention of the Iowa Electrical Association, Prof. A. H. Ford, of the State University of Iowa, discussed the selection and design of a distributing system from the standpoint of cost and operating characteristics. The first part of the paper deals with the general principles of line loss as related to voltage, resistance, inductance and the effect on regulation, and the various systems of distribution are then taken up.

The systems in use at present are the two and three wire for direct currents and single phase alternating currents, and three and four wire, for two phase and three phase alternating currents. These systems may be designed from either of two standpoints—the maximum potential which exists between any two conductors or the minimum potential which can be obtained from the system. The maximum allowable potential is determined by the insulation of the line, which presents no great difficulties if the potential is not over 5,000 volts. The minimum potential obtainable from the system is determined by the maximum potential for which receiving devices can be built, which is about 2,200 volts for small transformers and 230 volts for incandescent lamps. The conditions of economy demand, therefore, that the line potential shall approach as near as possible to 5,000 volts and still be able to get the lower potential required by the receiving devices The line connections and relative weight of conductors for equal loss of power on the basis of equal maximum potentials and equal minimum potentials are shown in the accompanying table.

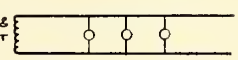
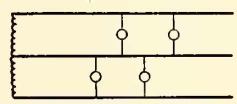
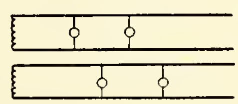
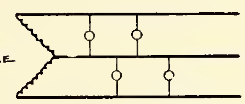
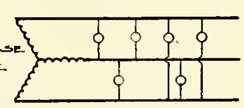
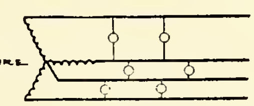
The relative weight of conductors for the same maximum potential is given merely to show the difference in the results obtained by the two methods of calculation; for the limitation of receiver potential always keeps the maximum potential below that for which it is possible to insulate the line, no matter which of these systems is chosen.

In this table the value 50 under the maximum potential for the two wire system refers to direct current operation. It will be recalled that for the same effective value of e. m. f. the maximum alternating voltage is $\sqrt{2}$ times the direct, and hence on the basis of the maximum e. m. f. only 50 per cent. as much copper will be required for the latter as for the former.

Single Phase Alternating Current and Direct Current Systems.

The great economy in conductors leads one to use the three wire system instead of the two wire system for low potential circuits except where a very small amount of power is to be transmitted, or the receiver potential is greater than 250 volts. The distance to which power can be transmitted with the same loss, receiver potential and weight of conductor, is increased 63 per cent. by the use of a three wire system with the neutral of the same size as the outside conductors. The increased distance to which power can be transmitted from a transformer with a three wire secondary as compared with one having a two wire secondary and the same receiver potential, frequently makes it possible to connect all the customers in a couple of blocks, in a residence district, to one transformer, with a reduction in the transformer capacity to less than half what it would be if each customer were supplied with a separate transformer. This statement has been made so often that it may seem unnecessary to some; but it is not uncommon at the present day to see several small transformers placed within a couple of hundred feet. It is advisable to interconnect the secondary circuits of adjacent transformers so that they will aid each other when the maximum load does not come on both at the same time. When that is done the secondary of each transformer should be fused.

The same theoretical considerations would lead one to use the three wire system on the primary circuits also; but it is not done on account of the extra complication which it would require at the power station, the same result being more easily accomplished by running the two wire system at a higher potential. When the line potential is 2,300 volts the size of many of the conductors is determined, not by electrical considerations, but by the strength of the wire, it not being advisable to use wire smaller than No. 8 gauge.

System	Connection	Maximum Potential	Minimum Potential
Single Phase & Direct Current Two Wire		100 50	100
Three Wire		150	37.5
Two Phase Four Wire		100	100
Three Wire		145	72.4
Three Phase Three Wire		75	75
Four Wire		100	33.3

Relative Weight of Copper.

The low potential at which direct current circuits must be run limits their use to districts where the load is very much concentrated.

It is desirable that the load be equally divided between the two sides of the system at all times, for the regulation of each side is dependent on the load on the other. If the two sides were equally loaded and the load should be thrown off one side, the potential on the other side would fall an amount equal to the difference between the generator potential and the receiver potential when the load was equal on the

two sides, and rise twice this amount on the side from which the load was removed. The load is usually kept balanced within 10 per cent., which is accomplished by wiring each customer's premises on the three wire system and distributing the load as equally as possible.

Two Phase Alternating Current Systems.

The two phase four wire system may be regarded as two single phase two wire systems, as far as the lighting load is concerned, two phase feeders being required only where it is desirable to operate polyphase motors. The lighting feeders are frequently run from the power station as entirely independent single phase circuits. The circuits will be dependent upon each other to the same extent as if run from a single phase system, this dependence of their regulation depending on the regulation of the generators.

The three wire system requires much less weight of conductor, but this saving is at the expense of the regulation, which is dependent on the drop in the common conductor in much the same way that the regulation of a single phase three wire system is dependent on the drop in the neutral. The dependence is greater in this case for the current in the common conductor is 1.41 times that in each of the outsides when the load is balanced, instead of being zero, as is the case in the single phase system. A considerable saving can be effected by running the three wire feeders to the centre of the distribution and running single phase feeders from there. The three wire system also unbalances the mechanical load on the cross arms unless a six-pin arm is used, each arm carrying two circuits of the same size, with the common conductor of the odd circuit mounted on the top of the pole.

No matter which two phase system is used, it is advisable to have the load balanced between the two phases at all times. This requires that care be used in connecting supply circuits so as to get customers of the same class balanced on the two phases.

Three Phase Alternating Current Systems.

The three phase three wire system requires practically the same weight of conductor as the two phase three wire system and with a corresponding dependence of the regulation of the potential of each phase on the load on the other phases, the dependence being greater in this case. The problem of balancing the load is greater, as it must be balanced among three phases. It is not necessary to carry more than two conductors to places where there are no polyphase motors.

The three phase four wire system makes use of a neutral conductor which serves the same purpose as the neutral of the single phase system and carries no current as long as the load is balanced among the phases. The line potential is 1.73 times that of the three wire system, which accounts for the decrease in the weight of the conductors. It is the cheapest system to install of those given, and is largely used in factories where the load consists princally of polyphase motors, for, by using 115 volt lamps and 200 volt motors, the advantages of a high motor potential can be obtained without the use of transformers for the lamp load. In some cases 230 volt lamps are used with 400 volt motors, for the saving in the cost of the conductor system more than makes up for the lower efficiency of the lamps. The same system may be used for the primary distribution circuits without introducing much more complication than the three wire system requires.

As a motor load is very desirable, it is necessary to discuss the various distribution systems with reference to their availability for such loads. The direct current motor is the only one which can be run satisfactorily as a variable speed machine, and, therefore, is an absolute essential for much motor work. The possibilities of developing a motor load of this kind are so great in many places as to determine the choice of a direct current three wire system at a great increase in the cost of the distribution system over that for an alternating current system. Where such an expense is not warranted by the motor load alone, it may be, by giving the possibility of installing storage batteries to act as insurance against shut-down and help the generators out on the peak load.

Where storage batteries are to be utilized, it is advisable to put them at the sub-centres of distribution and not at the power station. The use of the storage battery as a means for improving the regulation and reducing the cost of the distributing system has been much neglected except by the largest stations. Where the installation of a 230 volt three wire system is not warranted, a direct current motor load may be obtained by the use of a 500 volt circuit for power purposes only. This requires the use of special machinery in the station and a special distributing system, and this is not often resorted to. Where a motor load can be developed in a small district some distance from the power station, it may be advisable to install a motor generator set, if arrangements can be made for its care by some customer who operates a large number of motors and on which premises it is located.

Where alternating current generators are used it is advisable to use polyphase machines on account of their greater output per unit cost and the possibility of running large motors from them. Self-starting single phase motors are built as large as 25 horse-power, but they take such a large starting current that their starting has a very detrimental effect on the regulation of the line: it is, therefore, not advisable to use them in sizes larger than 10 horse-power. Induction motors are very satisfactory as long as variable speed is not required.

Two phase distributing systems have an advantage over three phase systems in that the load is required to be balanced between two phases instead of among three. This balancing does not have to be done very accurately if each phase of every feeder is provided with a potential regulator, and this not a point of great moment. Three phase motors require three service wires and three transformers, while two phase motors require four service wires and two transformers. It is possible to run three phase motors from two transformers, but this is not done except for very small motors on account of requiring the installation of transformers of twice the capacity of each of the three transformers. The total transformer capacity will, therefore, be 1.33 times what it would be where three transformers are used for each motor. There

is practically no difference in the electrical characteristics, such as efficiency, torque, slip, etc., of two and three phase motors.

The three phase four wire system requires the least weight of conductor and has the highest potential between conductors; this is somewhat of a disadvantage, for it is almost a necessity to work on the distributing system while it is alive. This system requires special generators and oil switches at the power station when the potential is 2,300 volts. The generators are special only as to the potential, which must be 4,000 volts, and an extra conductor connecting to the centre of the Y-connected armature.

The writer is of the opinion that when the load is concentrated within approximately half a mile of the station and there is the possibility of a considerable variable speed motor load being developed, it is advisable to install a direct current three wire system with a potential of 115 volts on each side. By increasing the potential to 230 volts, a great saving in conductors is accomplished, but this is offset by lower lamp efficiency and increased trouble with cut-outs, switches, etc., on customers' premises. When the load is scattered, a polyphase system should be installed —two phase four wire for plants under 1,500 kw. capacity and three phase four wire for plants larger than this. The transformer potential is preferably 2,200 volts primary, with a three wire secondary having 110 volts on each side. The secondaries of all lighting transformers on each phase and feeder should be interconnected where it can be done without extending the circuit more than 200 feet. Separate transformers should be used for the motor load, though each motor need not under every condition be supplied with a separate set of transformers.

AN INTERVIEW WITH MR. FREDERIC NICHOLLS.

"The general feeling among British investors is very favorable to Canadian enterprises in view of the fact that their own home railway and South African securities, which have been their favorite investment heretofore, are receiving but scant attention at the present time." Thus Mr. Frederic Nicholls, general manager of the Canadian General Electric Company, and vice-president of the Electrical Development Company, summed up the situation when seen by "The Globe" on his recent arrival from London.

"Of course," Mr. Nicholls continued, "Canada is becoming more widely known, and, apart from any political aspect of the situation, the mere fact of the presence of Sir Wilfrid Laurier and the Canadian Ministers in England at the Imperial Conferences from time to time is bound to have the effect of creating a better understanding of Canada's present and future prospects."

Mr. Nicholls stated that while in England financial arrangements had been made, satisfactory to the company, which enables them to complete their plans and be in a position to take care of the business now offering. "We are now in a position to complete the development of 60,000 horse-power, which will provide for the immediate requirements of our customers," he added.

Touching upon the hydro-electric problems of Europe, Mr. Nicholls said there were few water powers of moment on that continent, which precluded any great engineering undertakings in this direction. The company with whom they had recently formed an alliance have had their engineers to Victoria Falls in South Africa to make a study of the development and transmission plans, which will ultimately be of more importance than at Niagara. But while in Europe and Asia there are few water powers, and these are very widely scattered, no country in the world has such water powers as Canada. In explaining the situation to a London editor, Mr. Nicholls recently said:—"See how magnificently our Canadian cities are situated as regards water powers and electrical supply. Starting from the east, we have Quebec supplied with power developed from several large waterfalls. Montreal is supplied by power developed at Shawinigan and Chambly. Ottawa is supplied from the falls there. Toronto, Hamilton and other Ontario towns are supplied by power radiating from Niagara Falls. Port Arthur is supplied by power developed on the Kaministiquia River. Winnipeg by power developed on the Lac du Bonnet, and Calgary from the Bow River. Vancouver and Victoria, on the Pacific coast, are supplied by hydraulic developments in close proximity to each city. Such a state of things is unique; it shows that every large city in the Dominion—across a continent of 3,500 miles—is now absolutely independent of coal supply for the production of its light, heat or power."

TRADE NOTES.

The Montreal General Hospital have placed an order with the Robb Engineering Company for two 150 horse-power 72 inch x 20 foot return tubular boilers.

W. P. McNeil & Company, New Glasgow, N.S., have recently ordered from the Robb Engineering Company a 150 horse-power Robb-Mumford boiler with steel case.

The A. J. Burton Saw Works of Vancouver have recently increased their power by the installation of a 50 horse-power 2,000 volt inductor motor of Westinghouse manufacture.

The Electric Turpentine Company, of Vancouver, have recently ordered a Westinghouse switchboard, fully equipped with circuit breakers and instruments to be used on their plant now under construction.

The Centre Star Mining Company, Rossland, has purchased a 600 horse-power synchronous motor for operating an air compressor from the Westinghouse Company. The order included all the necessary switchboards and controllers.

The Canadian Rand Drill Company, Sherbrooke, P.Q., have ordered from the Robb Engineering Company one 11 inch and 16 inch x 14 inch Robb-Armstrong tandem compound engine, arranged for direct connection to a 75 kw. generator.

The Westinghouse Company, through their Vancouver office, are furnishing the Vancouver Ice & Cold Storage Company with a 100 horse-power motor for operating their ice machine; also a 50 horse-power motor to the British Columbia Market Company for their cold storage plant, and a motor to Porter & Sons for their cold storage plant.

The Robb Engineering Company, Amherst, N.S., have recently received the following orders:—One 80 horse-power Robb-Armstrong engine for N. & M. Smith, Halifax, N.S.; one 125 horse-power Robb-Armstrong engine for the Columbia River Lumber Company, Golden, B.C.; one 80 horse-power Robb-Armstrong engine, arranged for direct connection to 50 kw. generator, for the Temiskaming & Northern Ontario Railway; one 80 horse-power Robb-Armstrong engine, from Canadian General Electric Company, for the Canadian Pacific Railway; one 100 horse-power Robb-Armstrong engine for the Canadian Westinghouse Company, Hamilton, Ont.

THE ELECTRICAL CONVENTION AND EXHIBITION.

All signs point to a very large gathering of the electrical fraternity in Montreal during the first two weeks of September. The Electrical Exhibition which is to be held by the Canadian Electrical Exhibition Company will open in the Government Drill Hall, Craig street, on Monday, September 2nd and continue for two weeks. A large number of manufacturing and supply firms have already contracted for space and there promises to be an exhibit of electrical apparatus which will be most interesting and instructive. Mr. R. S. Kelsch has undertaken the management of the Exhibition, which ensures its success.

The annual convention of the Canadian Electrical Association will be held in the rooms of the Canadian Society of Civil Engineers, Dorchester street, Wednesday, Thursday and Friday, September 11th, 12th and 13th. A number of interesting papers have already been arranged for. Mr. R. M. Wilson, superintendent of the Montreal Light, Heat & Power Company, will present a paper on the very interesting subject, "How to Increase the Load Factor," and Mr. M. A. Sammett, of the same company, will discuss some of the difficulties encountered in operating alternating current systems. Other equally interesting papers will be submitted on "Frazil Ice," "New and Old Type Incandescent Lamps," "The Nernst Lamp," "Electric Heating and Cooking Appliances," etc. There will also be a splendid programme of entertainment, and a visit to Montreal during the early part of September is bound to be one of pleasure and profit to all electrical men.

Remember the date of the Canadian Electrical Association Convention, September 11th, 12th and 13th, and let us have a record attendance.

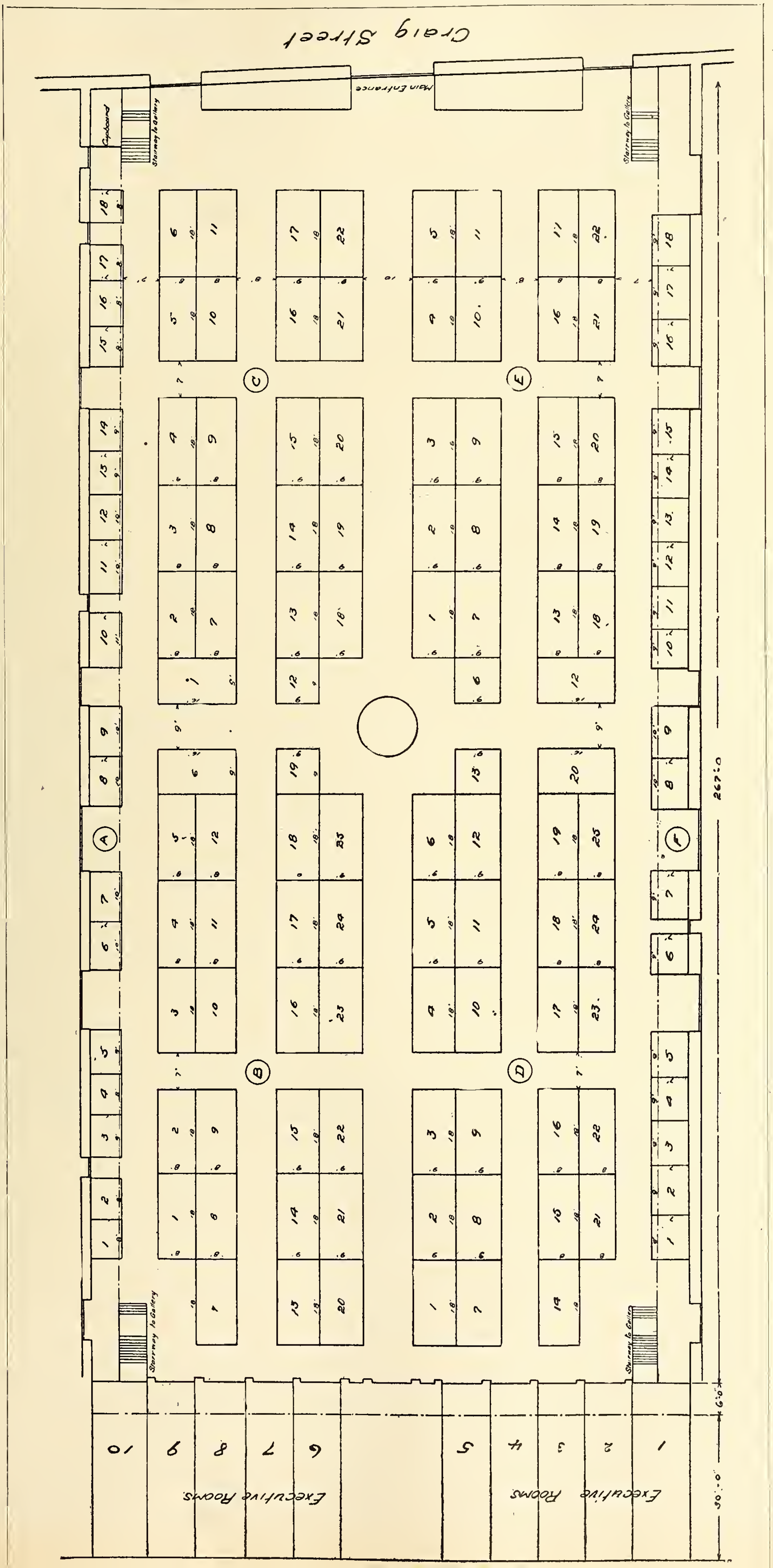
CEMENT INSULATED TROLLEY HANGERS.

S. H. Anderson, chief electrician of the Pacific Electric Railway, Los Angeles, Cal., has been experimenting with a novel type of insulated hanger for trolley construction. The variation from the present type of hanger consists in the use of Portland cement as an insulating compound. The outside or shell of the new type of hanger will not differ from the design now generally adopted. The interior stud, however, which supports the ear will be made in a die in the form of a spool with the threaded portion as an extension from the face of one end. This spool-shaped piece will be centred in the shell and the interior of the shell then be filled with Portland cement. Insulation will be provided by covering the stud with two or three coats of enamel baked on so that it will be unaffected by water. The cement which will replace the usual insulating material will therefore not be called upon to act as a dielectric, but only to perform the mechanical duty of retaining the hanger bolt in the position in the centre of the shell. It is expected that this method of consruction will effect a saving in first cost.

GOVERNMENT DRILL HALL, CRAIG STREET, MONTREAL, WHERE THE ELECTRICAL EXHIBITION WILL BE HELD SEPTEMBER 2 TO 14, 1907.

The construction of a 50-mile telephone line for the private use of the Grand Trunk Pacific Railway connecting Prince Rupert and Aberdeen was completed last month.

Mr. Robert Peake, who recently left St. John, N.B., to accept an important position with the C. P. Telegraph Company at North Bay, is one of the best known telegraph men in Eastern Canada, having been in the service of the Western Union Telegraph Company for the last 23 years. He has been connected with the St. John office, in charge of the electrical equipment, and to his untiring efforts and ability is largely due the efficient service rendered by the Western Union Company throughout that section of the country. Before leaving Mr. Peake was waited on by the staff and presented with an address and a handsome travelling bag.



FLOOR PLAN OF DRILL HALL, CRAIG STREET, MONTREAL, WHERE THE ELECTRICAL EXHIBITION WILL BE HELD SEPTEMBER 2 TO 16, 1907.

THE SERVICE UNIT SYSTEM OF CHARGING.

A question which has bothered the central station people along the line of rates is how to differentiate between different customers. If the company is legally allowed to make different rates to different customers, under different conditions, how shall that be accomplished, so that all customers can get the right rate?

We have in our plant one scale of rates for all customers, from one light to 1,000 lights, from $1 a month to $600 or $800 a month. When a customer gets out of one class and goes into another, he gets the benefit of it without any special agreement. It is not entirely on the plan of charging a certain rate for the first hour's use and another rate for the second hour's use per day, but it provides for something which that method does not provide for. Our rate goes farther and provides for the large as well as the small customer, at the same time providing for the short hour customer.

Instead of using one hour per day, or two hours per day, as the basis of the sliding scale, what we call a service unit is used as the basis. That service unit is composed of two factors, first, a certain number of hours' use, and second, a definite fixed amount of kilowatt hours, supplied to all customers alike.

For instance, five hours' use of the capacity demand, plus six kilowatt hours, is the basis of the sliding scale. The first five hours plus six kilowatt hours in our rate is charged at the initial rate, the maximum rate; the second five hours, plus six kilowatt hours, or the second service, at the second rate; the next five hours, plus six kilowatt hours' consumption, at the third rate, etc.

We find that that takes care of all classes of customers, with the curve of rates very closely approximating our cost curve for the different classes of service. The plan can be varied, of course, by changing the figures for these various points, or for the number of hours' use, and the number of services to be charged at a certain rate.

As an illustration, our rate is 16 2-3 cents per kilowatt hour for the first service rate (first five hours' use of the capacity plus six kilowatt hours). The second is 15 cents; the third, 10 cents; the next 10 service units are three cents, and all beyond 13 service units are one cent per kilowatt hour. The one cent rate is only the consumption after all the fixed costs are taken care of by the higher rates, with any additions which entail additional costs on the company.

It seems to me that some of the central station rate problems can be solved along this line.

There is some objection to rates of this kind on account of the complication. Customers do not understand either the justification for a rate of the kind or the rate itself. The difficulty is, if you make a rate that the customer can understand, then he cannot figure it out; if you make it so that he can figure it out, he cannot understand it. That is, if you put it on a basis where he can understand the meaning of the terms, then he cannot apply it to the different classes of load. We have been reasonably successful with this class of rates, and have overcome not only our difficulties in rate schedules, but largely the legal objections also.

MARSHALL FIELD & COMPANY ADOPT NERNST LAMPS.

The largest contract ever placed for lamps for store lighting has just been awarded by Messrs. Marshall Field & Company, of Chicago, to the Nernst Lamp Company of Pittsburgh. It calls for 12,000 glower units for immediate delivery. The store will be equipped a section at a time, and on account of the vastness of the undertaking the complete instalation will perhaps not be in operation until well into the fall.

Perhaps no store in the whole world is better or more favorably known than the great merchandising establishment of Marshall Field & Company, but only those who have had the opportunity and time to walk leisurely over its thirty-eight acres of floor space and view its wonderful displays of merchandise, collected from all sections of the world, are able to appreciate its magnitude. The store has a frontage on State street of 385 feet and covers almost the entire block bounded by State, Washington and Randolph streets and Wabash avenue. The average number of employes is 9,000.

For some time the rebuilding of a large portion of the store has been in progress, and in order to have the entire property in keeping with these improvements it was determined to install a new lighting system throughout.

Any change in the equipment of such a vast store necessarily involves too great an expenditure to warrant the adoption of any system until thoroughly tried out, and so, at great expense, various modern systems of store illumination were installed in different sections of the store and put to an exhaustive test before a decision was reached. In having been chosen as best suited to the various requirements of this great store, the Nernst system has received as high a mark of commendation as it would be possible to bestow.

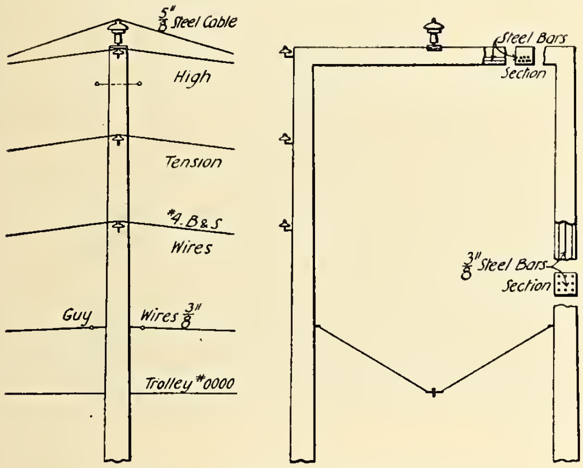
Recognizing the importance of having a lighting system that would be in keeping with the architectural features and the general tone of the store, that would be agreeable and pleasing to the eyes of the customers and show up fine textures and delicate tints in their true values and at the same time be flexible enough to admit of a uniform value throughout, Marshall Field & Company in trying out the various systems subjected them to perhaps the longest and most exhaustive test ever made.

The thirteen floors to be lighted vary in ceiling height from 14 to 19 1-2 feet. Two and three glower lamps suspended on specially designed chain pendants hanging from three to five feet from the ceiling—according to height—will be used. The fixtures are particularly appropriate in design, and the lighting units will add materially to the appearance of the store.

Incandescent lamps to the number of more than 40,000, in low hanging fixtures, were formerly used. The current is supplied by the Chicago Edison Company. Messrs. D. H. Burnam & Company are the architects in charge of the new building construction, now practically completed. The new lighting system will be installed under the direction of Mr. F. J. Pearson, electrical engineer for Marshall Field & Company.

REINFORCED CONCRETE TROLLEY ARCHES.

E. Darrow, general manager and chief engineer of the Toledo & Indiana Railway, Toledo, Ohio, has developed an original idea for catenary direct current trolley suspension, consisting of reinforced concrete arches instead of the ordinary wood or iron poles. This new construction, which is illustrated in the accompanying engravings from sketches furnished by Mr. Darrow, will be adopted on the company's extension from Bryan, Ohio, to Waterloo, Ind., and will probably be used to replace the present wooden

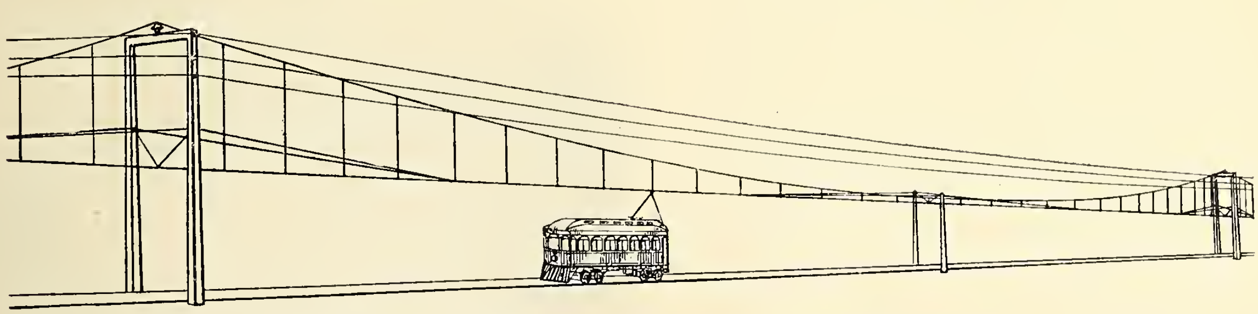


Concrete Trolley Arches—Details.

pole construction on the original line from Toledo to Bryan as the pole construction requires renewal.

The arches will be set 9 feet in the ground and will extend 40 feet above the ground. They will be 12 inches square at the base and taper to 9 inches at the top. The vertical columns will be reinforced by eight and the bent by seven 3-8 inch steel bars, arranged as shown in the drawing. Midway between the arches, which will be spaced 650 feet apart, will be placed two concrete poles to support the 3-8 inch bridle guys, which are anchored to steel eye-bolts in the concrete. The trolley will be also braced by bridle guys and sway braces anchored to the sides of the arches, as shown in the drawings. A 5-8 inch steel cable will be used for the messenger wire which supports the No. 0000 trolley wire. The high tension wires, of No. 4 hard-drawn copper, are suspended on insulators on the outside of the columns, as shown, spaced 36 inches between centres at the points of suspension.

The cost of one section of the above construction, ready for wires, is $107, as compared with about $90 for the ordinary wood pole construction, with bracket fixtures.—Electric Railway Review.



Concrete Trolley Arches—General Design of Catenary Suspension.

MONTREAL LIGHT, HEAT AND POWER COMPANY.

The annual statement of the Montreal Light, Heat & Power Company, issued last month, makes a very satisfactory showing. The report of the president, Mr. H. S. Holt, is given in part below:

"The gross earnings for the year amounted to $3,453,490.34, and the net profits, after providing for fixed charges, interest, etc., to $1,440,582.06, being an increase over the previous year of $267,387.60 gross and $162,095.75 net. The increase in both the gross and net earnings is considered satisfactory, more especially the latter, in view of the continued increased cost of material and labor.

"There have been declared out of the year's net profits four quarterly dividends of one and one-quarter per cent. each, amounting to $850,000.00, leaving a balance of $590,582.06, which added to the surplus of $901,158.12 brought forward from last year, brings the surplus to $1,491,740.18, out of which appropriations have been made to the amount of $386,892.25, as follows:—Depreciation, renewals, etc., $255,000.00; insurance fund, $56,892.35; contingent account, $50,000.00; suspense account, $25,000.00.

"The object of the suspense account is to provide for damage suits, adverse litigation, etc., and, with the amounts previously transferred to it, has at its credit, as will be noted by the balance sheet, the sum of $76,337.99.

"During the year the company has completed the erection of a dam on the Richelieu river at Ste. Therese.

"The company has added to its steam plant at Queen street station a 2,000 horse-power turbine unit, and now has available at this and its other steam stations a total capacity of 8,000 horse-power. Your directors advise that additions be made to your steam plants for reserve purposes from time to time.

"The contractors for the Soulanges development, to which reference was made in your directors' last annual report, have not made the progress anticipated on this work, as a consequence of which the power from the proposed plant was not available to the company during the past winter.

"Your directors contemplate extensive additions in the carbonizing and storage plants of the gas manufacturing department to provide for the increased demand being made for gas.

"The increase in the company's business continues to be most satisfactory, the following additions having been made during the year:—

"Electrical Department.—Incandescent lamps connected, 41,655; commercial arc lamps connected, 266; street lamps connected, 33; power connected, 4,884 horse-power.

"Gas Department.—Meters installed, 5,747; stoves, generators, etc., installed, 2,501; new services put in, 1,958, or 12.7 miles; new mains laid, 11.14 miles.

"Commerce and industry generally in Montreal continue prosperous, and the prospects for additional business in the future are most favorable."

SOME EXPERIENCE AT SHAWINIGAN FALLS, QUEBEC

Chas. F. Gray,
Superintendent of Construction, Canadian Westinghouse Company, Limited.

The Shawinigan Falls, where the power plant of the Shawinigan Water & Power Company is located, are eighty miles north of Montreal at the junction of the Shawinigan and St. Maurice rivers. This plant is becoming one of the most important in the Dominion of Canada. Power is transmitted at 50,000 volts from the falls to Montreal, where it is used for street railway and power purposes. There are five two phase thirty cycle alternators installed, having an aggregate capacity of 25,000 kilowatts. These are direct connected to waterwheels operated under an average head of 130 feet. The fifth generator, which is of 6,600 kilowatts capacity, has just been installed within the last year.

Some points regarding the installation of this generator, which was under the writer's direction, may be of interest. The power house is so situated that the installing engineers had many difficulties to contend with, chiefly in the lowering of the apparatus to the power house, as it is near the water's edge below the falls and about 160 feet below the level of the tracks on the embankment above, where the apparatus was delivered on cars. It was necessary to get the apparatus down a steep grade from the cars at the top of the hill and into the power house.

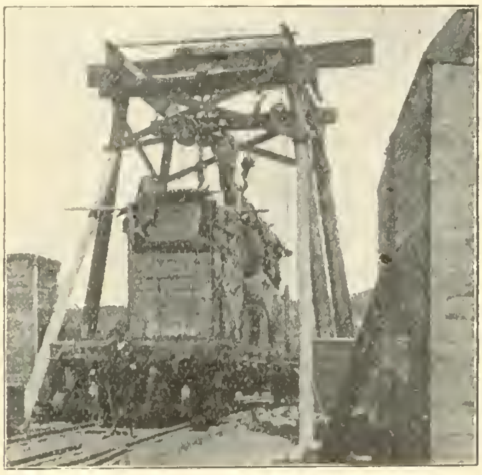


Fig. 1.—Unloading Gallows with Transformers in Position for Unloading.

An excellent unloading tower was rigged up by Mr. R. C. Argall, superintendent of construction of the Shawinigan Company, for use in unloading and lowering the heavy apparatus to the power house. This is shown in Fig. 1, with a carload of transformers in position ready for unloading. At the head of the incline two sets of anchor posts, each composed of three heavy pine snubs, were placed in the ground to a depth of about six feet and about seven feet apart. These posts were imbedded in concrete blocks three feet square. Across the posts was placed a heavy I-beam, and to the centre of this the upper block of the lowering tackle was fastened, as shown in Fig. 2. The apparatus being lowered was attached to the lower block. Five thousand feet of two and one-half inch rope was used on this lowering tackle. The fall end of the rope was passed around three heavy snubbing posts in succession, and the loose end held by three or four men. The posts were set seven feet in the ground and solidly imbedded in concrete. With this outfit six car loads of heavy apparatus, varying in weight from 15 to 60 tons, were unloaded in two days of ten hours each. The loaded cars were run under the tower or lifting gallows and the apparatus lifted off the cars, lowered to the ground and rolled to one side, as shown in Fig. 1.

The ground from the railway track down to the power house, 525 feet distant, was very rough, but by

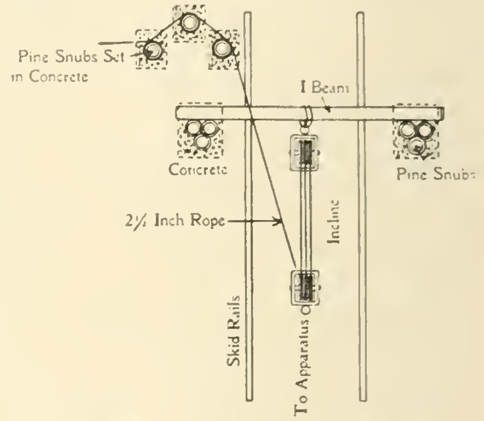


Fig. 2 Arrangement of Tackle for Lowering Apparatus.

a great deal of work and gradual development a first-class skidway was made, on which the apparatus was lowered. Fig. 3 shows this skidway at the time one of the waterwheel draft tubes was being lowered. This view also shows the gate house and penstocks leading to the older power house and the new addition, as well as giving a general idea of the magnitude of the work.

In Fig. 4 is shown the method of unloading the 55-ton top case of one of the waterwheels. An evidence of the effective way in which the apparatus was handled is given from the fact that the time taken to lower

Fig. 3.—General View of Gatehouse, Penstocks Leading to the Older Power House and to the New Addition.

this piece of apparatus, from the placing of the slings to receiving at the power house entrance, was only thirty-five minutes.

A great deal of unloading was done in the midst of a Canadian winter, and while the ice and snow made it easier to skid apparatus, at the same time it called for considerable extra care on the part of those engaged in the work. Most of the rough labor em-

ployed on this work was the typical "Habitant" of Northern Quebec, who makes up for his lack of English by his willingness to work.

One feature of interest in connection with the installation of the 6,600 kilowatt generator was that this machine was wound after reaching the power house, the armature and field coils being sent from the factory. This generator is shown in course of installation in Fig. 5. After the field coils and the copper dampers were in place the dampers had to be turned down to the exact size. This was rather a

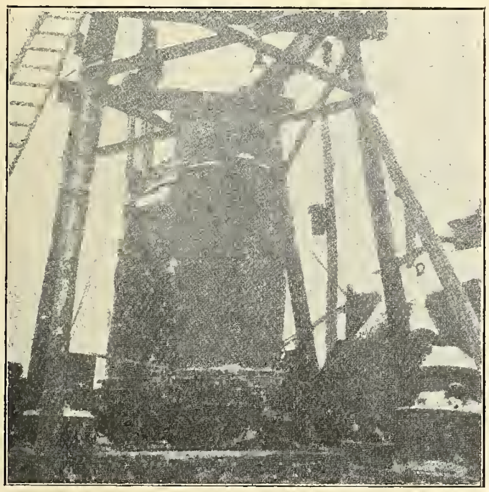


Fig. 4.—Unloading Top Case of Water Wheel.

ticklish proposition on a generator of such large size, as it was very difficult to get the waterwheel to run slow enough for turning purposes. Another difficulty was that the cut was an intermittent one, as the tool would jump from damper to damper as the field revolved. However, a tool rest was rigged up in front of the revolving field and the speed kept as low as possible by regulating the water supply. The wooden

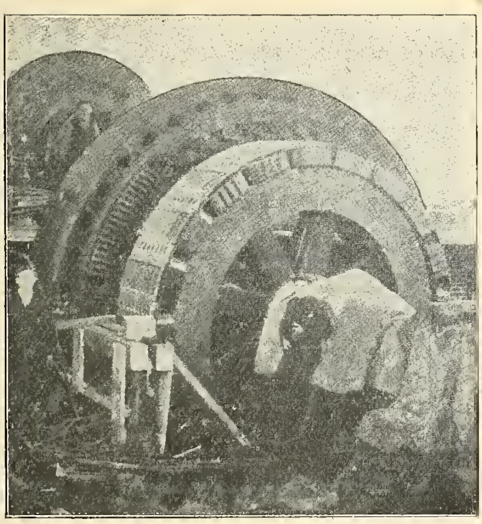


Fig. 5.—Interior of Station Showing One 6,600 K.W. Generator in Course of Erection.

support for the tool rest is shown in position in Fig. 5. It was necessary to remove about one-sixteenth of an inch of material. The operation proved successful and the work was done as neatly as if it had been done in an electrical factory, the chief drawback being that the speed was rather high for such work.

Another feature of interest in this installation was that one bearing of the generator had to be raised one-fourth inch higher than the other in order to bring the couplings in line. This became necessary because the waterwheel shaft had a sag of one-eighth inch, due to the weight of the runner, and hence the face of the coupling on the waterwheel was thrown slightly upward. The generator was the machine which had to be moved, because it was necessary to keep the turbine bearings level in order that another machine could be coupled on at the other end.—The Electric Journal.

A NOTEWORTHY SAVING IN OIL.

Although the value of an automatic oil feeder system for power houses is recognized, the first cost of installation is often considered too great for adoption in the smaller plants used in supplying current for railway or lighting purposes. Some time ago Levi Paxson, chief engineer of the Fort Branch (Ind.) power house of the Evansville & Princeton Traction Company, installed an oil feeder system that, because of its initial cost, and the oil and labor-saving features which it has developed, is worthy of comment.

Exclusive of the oil filters the system referred to cost but a trivial amount to install and has for nearly a year reduced the engine room expense more than $140 a month. Previous to its installation an oiler was employed on both the day and night shifts and the quantity of oil used was unusually large. At present no oiler is necessary and the oil consumption has been reduced to 40 gallons of engine oil and 30 gallons each of high and low pressure cylinder oil per month.

In installing the oiling device old gas pipe and other second-hand materials were utilized. The main storage tank, 60 gallons capacity, is located near the roof of the plant. Leading from this to the basement is a one inch pipe which passes up to the engine and is reduced to one-quarter inch where it enters the oil cups. The oil supply is furnished to the cups by gravity. The waste oil from the engine passes by gravity through another pipe line to a tank in the basement, from where it is forced by a small air pump to two Acme filters located in an oil room adjoining the engine room. From these filters the oil is returned to the storage reservoir by air pressure. The air pipe in this case is atached to the top of the filter reservoir. When it is desired to fill the storage tank the air cock between the filter and the filter reservoir is closed and the oil is forced to the top of the structure through a three-quarter inch pipe, which completes the circuit of the oil.

As a precautionary measure a small air whistle has been placed in the pipe leading from the filter to the storage tank. When the oil supply in the filter tank has been exhausted the air in passing through the pipes blows the whistle, which is a signal to stop the air compressor.

The machinery supplied by this automatic oiling device consists of two (18 and 36 by 42) engines, direct connected to a 400 kilowatt generator; two high speed engines direct connected to exciters, and a 300 kilowatt rotary converter.

The particulars regarding the improvements now being made by the Galt, Preston & Hespeler Railway, which appeared in the June number of The Electrical News, were reprinted from the Railway and Marine World, Toronto.

Specifications for Street Lighting*

In the year 1894 a committee of experts, appointed by the association to consider the rating of arc lamps, reported at the seventeenth convention, then in session at Washington, a preamble and resolution which was adopted as follows:

"Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy, the illuminating power of the arc lamp, and the great necessity for a more precise definition and statement of the obligations of the producer of electricity for illuminating purposes to the consumer thereof, be it

"Resolved, That in the opinion of this convention what is ordinarily known as a 2,000 candle-power arc lamp is one requiring on the average 450 watts for its maintenance, the measurements being made at the lamp terminals, where no sensible resistance is included in series with the arc. In case such resistance is used, it must be excluded in the measurement of the voltage."

The rating of arc lamps on the basis of energy consumed, as set forth in the resolution, was then and would now be satisfactory as an equitable means of determining either a proper rate of charge or illuminating value for street arc lighting furnished by a company to a municipality, under the same conditions, but at the time of the adoption of this resolution there was in use in the United States no type of arc lamp other than the open arc, which, although of many makes and designs, gave approximately the same illuminating power for a given amount of energy. Wherever the rating adopted by the committee in 1894 has been employed in connection with open arc lamps of the general type then in use, little or no difficulty has been experienced in the adjustment of differences arising from interpretations of contracts.

During the very year in which this rating was adopted, however, the commercial introduction of enclosed arc lamps began, and within the last ten or twelve years the gradual displacement of open arc by enclosed arc lamps has taken place. The manufacture of open arc lamps has practically ceased as a result of their inability to compete with the enclosed type, and manufacturers have devoted themselves almost exclusively to the latter until quite recently. During the last four or five years there have been placed upon the market a number of distinct new types of lamps, which have been known by the general designation of "flaming carbon" or "luminous arc" lamps, some of which originated from American ideas, while others were imported.

The characteristics of the various lamps mentioned, taken either individually or grouped in classes, are so widely at variance in performance in the ratio between light produced and energy expended that the difficulties experienced by operating companies are greater now than they were in 1894, and the preamble then adopted is equally applicable to-day by reason of the introduction of these new devices. In addition to the new types of arc lamps, there have also been placed on the market and are now offered for sale certain kinds of mercury-vapor or vacuum-tube lamps, which can be used for street lighting, as well as a considerable number of new incandescent lamps constructed of some form of metallized filament. Quite a number of the latter are already in use, with every prospect of their general introduction within a reasoble time. Any attempt to compare the illuminating value of these latest forms of lamps, which are or may be used for street lighting, on the basis of energy consumed, is not only futile, but would be ruinous to the contracting company, for while the so-called high efficiency lamps operate on a lesser expenditure of energy, they also give a larger volume of light. No reason can be given why a contractor should be penalized for giving more light than contracted for, after having made considerable investment for that purpose, simply because the number of watts consumed is less, notwithstanding that other items of expense and renewals may be considerably increased.

Your committee, after a most careful consideration of the difficulties to be met and for the purpose of establishing a definite basis, assumed: That, inasmuch as the lighting of streets by contract is a matter of illumination produced rather than of apparatus employed, the terms used in specifications should be in terms of illumination and not of energy consumed; that the individual lamp of each class should be the unit of number charged for; and that the average illuminating power of each unit should be comparable with and have a value equal to a known standard at proper relative distance. The following report is submitted as the best provisional solution of the problem of street lamp specification that the unsatisfactory existing state of the science and art of outdoor photometery permits.

The committee considers that street lighting lamps should not be rated in candle-power under contract specifications; because unless qualified as to the space distribution of the candle-power, such rating may be entirely misleading. The lamp may, by suitable reflectors, be made to possess a large candle-power in some particular direction or zone, and yet be very ineffective as a practical street illuminant. Consequently, the committee considers that the rating of street lamps in contract specifications should be in terms of the mean normal illumination cast at a considerable distance from the lamp, along the street which it illumines, i.e., the mean illumination thrown upon a plane surface at a considerable distance from the lamp and supported perpendicularly to the rays.

The following specifications are drawn to cover the ordinary conditions of street lighting, and are recommended to replace previous specifications, such as those appearing in the Report of the Committee on Rating of Arc Lamps of the National Electric Light Association at the meeting of 1894, a copy of which is reported above:

(1) Under ordinary conditions of street arc lighting, with lamps spaced 200 to 600 feet apart, specifications for street lamps should define the mean illum-

* Report of a committee composed of Dudley Farrand (chairman), A. E. Kennelly, Charles P. Steinmetz, Louis A. Ferguson and Paul Spencer, appointed to consider specifications for street lighting, read at the convention of the National Electric Light Association, Washington, D. C., June 5th, 1907.

ination thrown by the individual lamp, in position in the street, as measured at the height of the observer's eye and perpendicular to the rays, at some point not less than 200 nor more than 300 feet distant, along a level street, from a position immediateely below the lamp, with all extraneous light screened off and with no reflection from surrounding objects not forming part of the lamp equipment.[1]

(2) When using smaller units of light, such as series incandescent lamps spaced shorter distances apart, a correspondingly shorter distance from the lamp should be chosen in measuring the illumination.

(3) The lamp contracted for should give a mean normal illumination at the test point (selected as in Sections 1 and 2) not less than the illumination given by the stationary standard incandescent lamp of 16 candle-power at 1-x of the distance. The said standard incandescent lamp should be a standardized seasoned lamp, having a determined candle-power in a fixed direction.

(4) When the lamp tested fluctuates in intensity, a number of observations of the maximum normal illumination should be made at a distance of not less than 200 feet horizontally from beneath the lamp, and the average of these measurements should be taken as the average maximum illumination. A similar number of observations of the minimum normal illumination should be made, the average of which should be taken as the average minimum illumination. The arithmetical mean of the said average maximum and minimum illuminations should be taken as the mean normal illumination called for in Section 1.[2]

(5) A reasonable number of lamps covered by the contract should be tested.

(6) For measuring the mean normal illumination of a lamp, comparison with the standard incandescent lamp may be made either with a suitable portable photometer or with a reading distance instrument, such as the so-called luminometer.

(7) The unobstructed mean normal illumination must not be less at shorter distances than at the point of test.

(8) An approximate list of the mean normal illuminations thrown by street lamps of standard manufacture, at horizontal distances within the 200-300 foot range, hung approximately 20 feet above the level of the observers' eye, is given in the following table: [Data from which table is to be prepared are not yet completed. Table will be furnished later.]

1. The reason for leaving the horizontal distance flexible along the street within the range between 200 and 300 feet, is that a definitely specified distance such as 250 feet might be unsuitable for the purpose of the measurement. Within the horizontal distance in excess of 200 feet, the distance correction for the height of the lamp above the observer's eye is ordinarily unimportant.

2. (a) When a reading distance instrument is used for measuring the mean normal illumination at specified horizontal range, the average of a number of maximum distances at which a certain size of print can be distinguished may be called the average maximum distance, and the average of a similar number of minimum distances the average minimum distance. From these, the mean distance at which an illumination is cast normally, sufficient for distinguishing that size of print, can be determined. This mean distance must lie within the 200-300 feet horizontal range specified in Section 1. In most cases the arithmetical mean of the average maximum and average minimum distances may be taken as the said mean distance with an accuracy sufficient for practical purposes. The illumination needed for disinguishing the size of print may be determined for each particular observer from measurements of the reading distance with the standard incandescent lamp referred to in Section 3.

(b) When a portable photometer is used at a fixed horizontal distance, such as 250 feet, the mean normal illumination of a fluctuating lamp may be obtained by taking the average of not less than 50 observations at intervals of not less than one-half minute.

Your committee during the consideration of this subject invited to its meetings and sought the advice and assistance of a number of the most prominent illuminating engineers and arc lamp experts, and in that connection hereby expresses its appreeiation for services rendered by Dr. Clayton H. Sharp, Caryl D. Haskins, Frank Conrad, Carl Hering, Louis B. Marks and L. D. Howard Gilmour, and especially by W. D'A. Ryan for the quantity of data furnished to the committee for its use and the large amount of labor performed in the collection of additional data required in the preparation of the schedules.

HEAVY LINE CONSTRUCTION.

A part of the Niagara Falls Hydraulic Power & Manufacturing Company's transmission line at Niagara Falls, New York, which supplies the Acker Process Company with 8,000 to 9,000 amperes at 300 volts, is probably the heaviest overhead transmission line in the United States.

The total length from the generating station in the gorge to the terminal board, according to our contemporary, "Electrocraft," is only about 2,000 feet, as follows: 1,350 feet of aluminum busses, 350 feet consisting of 8 lead armoured copper cables of 2,000,000 circular mills, 12 No. 8 copper wires without core, and about 300 feet of same section, stripped of lead and insulation and carried 25 feet in the air by 10 to 12 inch poles spaced 40 to 50 feet. This is the part referred to above.

This line therefore weighs about 50 pounds per lineal foot and each pole supports about 2,500 pounds. The line is not grounded throughout, although the pots at the consumer's works generally are. The cables have Fletcher porcelain insulators with iron clamps and 5-8 inch galvanized iron guys which are laced to the cables and, as a protection, securely soldered. These guys have double, four inch lignum vitæ spool strain insulators. Two lines of six inch tile are used through walls and from conduits at surface of ground for 10 to 12 feet up the pole. The drop is normally about 22 volts or 6.8 per cent.

The conditions necessitating the overhead construction may be interesting. About 1902, when the circuit was completely underground a loss developed, rising gradually to 300 amperes when one negative and two positive cables were found cold and therefore not in circuit, as normally a fan was used to force cold air from manhole to manhole when operating at this capacity. When the above conditions were discovered the ducts opened, and, at a point where the line passed the hydrochloric acid vats of the manufacturer, fifteen feet away, the cables were found fused for about three feet, and there were indications of an arc over a partial breakdown in the cable due to acid corrosion from seepage, as well as an arc from positive to negative.

This arc and fused mass grew until at about three feet the resistance in each case became too great and it opened. The service was therefore being continued, with increased drop of course, by means of the remaining cable. The copper and lead of the cable, the clay joints and a part of the tile presented when exposed a very extraordinary appearance, being so fused that scarcely one of the metals could be recognized at some sections. The other two cables were approaching the above condition when the examination was made, while for about 15 feet each side of the disturbance all the cables around were badly pitted by acid. There were at least two bad leaks in the vats, one about a year previous, and one at the time of the trouble. As the ground about the conduit was saturated with acid it was decided, as mentioned above, to elevate the circuit throughout the affected district.

The installation and maintenance of this line is under the direction of B. F. Lee as electrical superintendent, with John L. Harper as chief engineer.

CANADIAN

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Standardization. The thanks of the whole electrical trade, and not only of those dealers and manufacturers who are usually considered as forming the trade, but also of the consumer as well, are due for the tremendous advance which was brought about when a standard was established to cover one of the most important items in the trade, namely, enclosed fuses. The consumer also has to be thankful for another blessing which has now practically come to him, and that is the adoption of one standard and uniform lamp base. It is true that the change has not been brought about without more or less opposition from those who were really deriving even more benefit than the manufacturers, namely, the purchasers and consumers of lamps, but now that the Edison base, which has long been recognized as by far the best, is practically the only one sold, everybody appreciates the great stride which has been made. Previous to these two reforms the situation, viewed from the light of the present day, was almost appalling. Every manufacturer and dealer was forced to carry three to four or five lines of each of the two articles, where one now suffices, besides which orders for repairs or replacements had to go into the minutest description of the style desired, or else when the man arrived on the ground he very frequently found that he had the wrong goods. Then the situation confronting the consumer, offered as he was a perfect maze of competing types, was of necessity so confusing as to almost make him resemble that manager who, in expressing his regrets to the Nernst Company, explained that he could not entertain their proposal because his generators were all General Electric. The good work, however, is not ended yet, as no good works ever are, and as the next subject which requires attention the matter of a set of uniform rules covering the inspection of wiring and wiring materials, is looming large on the horizon. We have of course the National Code, but the trouble is that in many places the inspection is in the hands of men who are not affiliated with the Underwriters, and who in consequence very frequently make local rulings which are a hardship not only to the contractor and the manufacturer, but also to the consumer, in that the latter must eventually pay, in delays or in money, for the special materials or the special ways of installing it which are frequently demanded. The National Code is the fruit of long experience and earnest effort on the part of both the Underwriters and installing and operating men. Surely it is complete enough and minute enough without the addition of local requirements, which but harass the consumer and which in the end must also work to the detriment of the lighting company. Inspection is most necessary, in fact it is vital to the success of the industry, because without it dangerous work is bound to go in, some-

times wilfully and sometimes through ignorance, but let it be carried out, whether it be municipal or otherwise, in the closest collaboration with both the operating company and the Underwriters, the one to ensure that all installations shall be inspected, and the other to the end that the rules and requirements shall be both thorough and uniform from one end of the country to the other.

Choice of Frequency.

It is but a comparatively short time ago when all but the very largest transmission plants were unhesitatingly putting in 125 cycle single phase apparatus. This was more particularly noticeable before direct connected alternators, following the lead of continuous current apparatus, began to make their appearance. The advent of this type of machine, however, with the practically simultaneous extension of the use of the induction motor, and the rise of the transmission line, soon made it evident that the costs and speeds of both generators and motors were going to be high, as were also the transmission losses, and so 60 cycles quickly made its appearance, and is to-day the great standard frequency of both this country and the States. It is eminently suitable for the operation of incandescent lamps, of stationary induction motors for all ordinary classes of services, and for arc lamps. Rotary converters also can be made to do good work from this frequency, especially when built for 125 or 250 volts, but it is not suitable in the slightest for alternating traction work. Besides this the line drops are of course higher than with a lower frequency.

It is perhaps this last consideration more than any other, though coupled of course with that of generator and motor speeds, which latter becomes more important as the units grow larger, that has made the large plants adopt 25 cycles as their standard. This frequency gives lower line drops than the other, a most important point when the output is large and the distance long, and also tends to improve the power factor. Sometimes it makes favorable induction motor speeeds, and sometimes it does not, but it is always accompanied by the disadvantage of higher transformer costs and losses; to say nothing of the fact that it renders alternating arc lighting almost impracticable. It is probable, however, that this latter objection will lose most of its weight as the mercury arc rectifier and the metallic electrode arc lamps become more fully developed; certainly this will be true of street lighting, which is the major field at present of this apparatus, and probably also of commercial arcs as soon as the smoking difficulties have been overcome. The foregoing applies only to plants which are operating lights, stationary power, or direct current railway apparatus, if single phase traction has to be considered 60 cycles is out of the question. The reasons for this are many, commutation, starting torque, maximum output, power factor, and last but not least, rail drop, all being very adversely affected by the higher frequency, so much so in fact as to make a 60 cycle single phase traction motor an utter impossibility. To illustrate one point only we would point out that the rail drop on 60 cycles is probably fifteen or sixteen times that of a corresponding direct current loss, which means that it alone is almost prohibitory, to say nothing of the other factors. To sum up, 125 cycles is too high for direct coupling and for transmissions of any magnitude, 25 cycles is unnecessarily low unless 500 volt rotaries, large and long transmissions or single phase railways have to be considered, and is entirely unsuitable for arc lamps, leaving 60 cycles as a very satisfactory medium for all ordinary plants, the material for which can be obtained more expeditiously than for any other, and apparatus from which is more saleable, assuming that enlargements render such a course desirable, than anything else. The main transmission lines from Niagara, whether or no they be Governmentally owned or operated, will be 25 cycles, but nevertheless it will probably be found advantageous, in the great majority of cases, to put in frequency changers and distribute at 60 cycles. There are of course other frequencies than the foregoing three, 15 cycles, for instance, being now quite seriously considered for single phase railroads, besides which in the States they have a few lonely 40 cycle plants. Over here we have escaped pretty luckily, 30 cycles of which we have one or two examples, notably Shawinigan, being about the only odd frequency existing. In great contrast to the policy on this continent of standardizing on three or four frequencies, and making one or other of them cover the ground, European practice seems to go to the other extreme, and to pick out some frequency which nobody has ever used before, if that be possible, for instance, such odd ratings as 46, 53, 71 cycles, etc., etc., being not in the least uncommon.

Modern Dam Construction.

In the June number of the "Engineering Magazine," Mr. H. von Schon, the well-known consulting hydraulic engineer, describes among the plants as representative of distinctly different types of construction, that of the Georgian Bay Power Company, whose plant at Eugenia, near Owen Sound, is getting well under way. The particular features of this development are, first, the use of a hollow reinforced concrete dam as opposed to the usual solid construction, and secondly, the fact that the pipe line for part of the way is carried through a 150 foot hill by means of a tunnel. This latter construction is very rare in eastern plants, though in California and British Columbia is has not infrequently been adopted as the cheapest and most satisfactory means of getting past obstructions. The principal advantages claimed by Mr. von Schon for the hollow dam construction, of which he is the designer, are several in number. First of all is the question of weight, as affecting both the first cost of the foundation, which manifestly will be considerably below that for the infinitely heavier solid dam, and also that of the life of the structure, the lighter design being comparatively free from the danger of settlement and consequent cracks. It is also claimed that the reinforcement renders the work less liable to damage from contraction due to falling temperatures. Besides this, the total cost is considerably less, and the work can be done in a much shorter time than is ordinarily required. A further advantage is that the interior, being accessible, is available for inspection and as a means of repairs and a place for storage, if such be required. As a matter of fact this latter feature, in a dam just completed for the Pa-

tapsco Electric Company, near Baltimore, is elaborated so as to allow the placing of the complete power house equipment in the dam, the spillway forming the roof of the generator room. Obviously though this construction could not be followed at Eugenia, because of the extremely high head, namely, 400 feet, which is the fall that is being utilized there. As a matter of fact such a head as this would itself make the Eugenia plant notable in Eastern developments, such falls as a rule being confined entirely to the mountainous Western districts. When combined, however, with the tunnel and hollow dam constructions it becomes almost unique among Canadian developments, and as such will be watched with great interest by all those interested in hydro-electric powers.

SOME ELECTRIC POWER EXPERIENCE.*

This paper is a statement of some lessons taught us by experience in the sale of electric power. We know now that we could have read most of these lessons in various text-books and printed proceedings. We have grouped them into one paper, hoping that the paper may help some other member companies that are learning by experience. In two years and four months we have added to our commercial power load 5,965 horse-power in alternating current motors and 3,862 horse-power in direct current motors, and in the last 12 months have increased our day load 50 per cent.

During this time we have followed the quite common practice of loaning and renting motors for trial installations. To do this it was necessary to carry a stock of motors that reached a value of $46,000 during the year 1906, when our average monthly gain in motor connections was 450 horse-power. When our power business showed decided and permanent growth, several of the local construction companies, seeing that their business could be increased if they could handle an entire installation, including motors, put in motor stocks and adopted our plan of trial on loan for 30 or 60 days, renting the motors for longer periods if purchase seemed likely in the future. This movement by the contractors is gradually relieving the central station of the necessity for carrying a stock of motors.

Our rental charge, after the loan period, was 25 per cent. per annum on net price of motor.

The company has always taken care of emergency cases, due to fire or breakdowns, of isolated plants at a minimum rate, and this custom has frequently led to permanent business. We have also found that considerable business may be done with contractors on construction work; and while this class of business occasionally requires extensions to our lines, we can well afford to make them, considering the advertising it gives electric power among contractors.

Observations taken in 100 factories at odd times show that on an average 50 per cent. of all the machines will be loaded at any one time, because operators preparing work or adjusting machines are idle, or for the moment away from the machines. This statement to a manufacturer will not often be credited until he has proven it by observation. The fact is, however, well known to our selling force, and is considered when specifying motors required and in estimating probable costs; and the saving of expense with metered central station drive against other power, due to this condition, is a good selling point.

Individual motors are not to be recommended unless a saving in current consumption equal to 20 per cent. per annum on increased investment will be effected. Except where individual drive is desired for special convenience, a less saving is not worth considering, as a customer would doubtless earn as much on the same money invested in his business.

In woodworking shops, individual motors displacing one large unit, have shown considerable saving. Instances: A shop operating a 20 horse-power motor, with average monthly bills of $40, installed nine motors aggregating 42.5 horse-power, and reduced its average monthly bill to $32, in addition to providing for increased output. In another shop a 10 horse-power motor was replaced by nine motors aggregating 28 horse-power, effecting a reduction of 20 per cent. in customer's bills, with the same work.

Customers should be influenced to use roller bearings on shafts, which bearings in some cases reduce the friction load of the shafting 20 to 25 per cent. as compared with good babbitt bearings; also to install shafts in separate short lengths where practicable, which is a decided advantage if part of the shop is run overtime or at times when the shop is operating only in part.

With large blowers it is frequently found that the fan is delivering more air than is actually required. In displacing a steam installation recently it was found that two ounces less pressure was sufficient for the work, and by reducing speed of fan we reduced the customer's bills about $15 per month. This brought cost of electric power low enough to compete successfully with steam.

In another instance we reduced the pressure at blower one ounce by moving it so as to shorten the length of the pipe by 100 feet, thus reducing load by six horse-power. In another installation of the same kind, four horse-power was saved by straightening several sharp curves on the blower pipe. The use of motors made these changes simple and cheap.

Our experience, as illustrated by these instances, has made us very suspicious of fans, blowers, air compressors and centrifugal pumps. The power required by these devices varies so rapidly with variation of speed that it pays to investigate every such machine in an installation and to make certain that it is not being run at a higher speed than is necessary to deliver the proper pressure. To run blowers needlessly fast is a very common fault.

In a small machine shop our engineer reduced friction loss by changing the location and piping of an air compressor, so that an intermittent small loss in an air pipe was substituted for a constant considerable loss in friction of a shaft. The electric drive was entitled to no credit for this, but got it just the same. In the same shop a portable desk fan, playing directly on tanks to be cooled, was substituted for a wooden blade fan that was bolted on each side of the end of line shaft. These changes effected a reduction of 15 per cent. in current consumption.

A shop manufacturing steel products asked us to install a 50 horse-power motor for three months, to take care of part of its plant while rebuilding boilers. This gave us an opportunity of studying its condi-

*A paper read before the National Electric Light Association at Washington, D.C., June 6, 1907. The authoress is sales manager for the Detroit Edison Company.

tions and before the three months were up we made the following recommendations: To install a motor-driven air compressor to supply air instead of steam to oil burners of forges, which change saved the cost of power in saving of oil; to arrange work so that the big grindstones were operated off our peak, thus giving the limited service rate for that service, and to do all work requiring high pressure steam two days a week instead of each day (this change greatly reduced their standby charges for steam and dispensed with services of one man); also to install a governor on air compressor to close inlet valve and allow compressor to coast until tank pressure fell to line pressure. With these economies and the usual cutting out of shafting the cost of operating the shop by electricity was reduced below its steam costs. The company equipped its shop with motors and at present has an installation of 150 horse-power with monthly current bill averaging $250.

By changing tight cross belts to wide slack open belts on a shaft driving 20 machine tools the power required was reduced three horse-power. In a polishing room where 10 double heads in one row with one exhaust fan at each end were operated we recommended placing the machines in two rows with one fan between the rows, which effected a saving of 8 h. p. In endeavoring to deliver the required power at a machine driven by a countershaft we changed the 12 inch pulleys on the main and countershafts to 24 inch pulleys with the desired result and incidentally reduced the load two horse-power.

By reducing speed of the line shaft in a large machine room from 220 to 190 revolutions per minute a saving of eight horse-power was effected without decreasing the output, as speed of tools was taken care of by cones.

A motor replacing a gas engine operating automatic machines by the improved speed regulation increased the output of the machines 10 per cent.—the constant turning moment permitting a heavier feed to the cutting tools.

In the foregoing case the output of the shop was increased because the steady motion given by a motor allowed a heavier cut to be taken than when the tools were driven by a gas engine. In other cases we have found that the cutting speed could be increased to a point higher than was possible with the unsteady gas engine drive.

In one small factory we were unable to discover why current consumption should be 25 per cent. higher than our estimate. We finally prevailed upon the manager of the concern to allow us to test out his machines, which his superintendent maintained were in excellent condition. After working for two days we found that the bearings in the air compressor were running on the iron of the boxes. Proper babbitting of the machines reduced the customer's demand two kilowatts, and we retained the business.

In the matter of factory lighting: We usually advise such customers to do their generol floor lighting with gas arcs, but to install individual incandescent lights at the machines. Since adopting this policy we find that we are relieved of the many complaints on lighting bills that were so frequent two or three months in the winter, when our factory customers would come to us with lighting bills that were sometimes as high as those for power. Our rate system makes a high price per kilowatt hour for lights operated for only a few hours annualy, while the gas company makes no difference between short hour and long hour customers, so all parties are satisfied by this division of service.

In this respect of willingly letting short hour factory lighting go to the gas company while we take the power business we believe our practice is unusual. We know that we get power business, which we very much want, by adopting this method; while if we insisted on getting the evening lighting the combined cost would be prohibitive. Other respects in which we think our power practice is unusual are that we have taken special pains to assist customers in keeping down constant losses, such as friction and windage, and that we regularly offer a reduction of the standard charge item of our price in consideration of a customer undertaking to refrain from using specified parts of his equipment during the hours of our winter lighting peak.

CANADIAN NATIONAL EXH BITION FOR 1907.

The prize list of the Canadian National Exhibition of Toronto, to be held August 27th to September 7th, is just out. Many changes are made, making it more convenient for reference by exhibitors. The regulations are altered so that all animals exhibited in the ilve stock sections must be registered in the Canadian Herd Book registers.

The directors have endeavored in every way to protect and encourage Canadian-bred horses, the prizes in the breed classes of the horse section having been increased over $600. Several new classes have also been added, including the one for strings of ten horses, which is expected to be one of the features of this year's exhibit.

In the speed division the prizes have been increased by $1,000, and a new classes has been added, providing for horses that are not fast enough for the "free-for-all," but that are too speedy for the 2.30 classes. The conditions remain the same.

In the cattle section A. T. Gordon, of Combscauseway, Scotland, has consented to judge the Shorthorns, which is the largest class in this section.

The general arrangement throughout the prize list this year is alphabetical, so that the finding of any section is simplified. The aggregate amount of the prizes is $39,000, not including the $3,600 given in the speed department. This is the largest purely agricultural prize list on the American continent.

ILLUMINATING NIAGARA.

Effective use has been made from time to time of searchlights at Niagara for iluminating the Gorge, etc. Citizens of Niagara Falls now propose to make a regular installation for the purpose, and Mr. W. D'A. Ryan, the illuminating expert, is giving his attention to the subject. At night Niagara is not seen except under moonlight, and it is believed that some very beautiful effects can be obtained by throwing artificial daylight on the scene, with color transitions.

NEW METHOD OF FASTENING INSULATORS*

By Carl Egner.

The method which is most used at present for fastening an insulator to its support consists, as is well known, in the support being wound round with black oakum, or the like, after which the insulator is screwed on over the oakum. This latter material does not contribute in the least to the insulation, but, on the contrary, diminishes it to a considerable degree, as filaments of the oakum often hang down and serve to conduct the electric current from the lower part of the insulator to the support. The fixing by means of black oakum needs great practice, as a workman un-

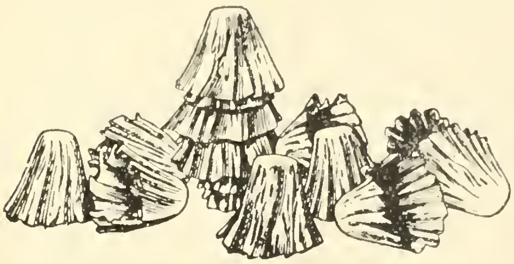


Fig. 1.

accustomed to the work finds it difficult to fasten the insulator properly, in addition to which the insulator easily cracks into pieces if the necessary caution is not observed.

In the new method of fastening the insulator the inconveniences just mentioned are obviated, at the same time certain advantage are obtained, as will be shown below.

The essential part of the new method is the use of insulating caps, which consist of extra strong durable paper, impregnated with insulating material. The form of the insulator caps is ilustrated in Fig. 1, and the way in which they are used in Figs. 2 and 3.

The insulating caps are placed to the requisite number upon the support, the one upon the other (Fig. 2), and are pressed together somewhat by the hand, so that there will be no great space between. The insulator is then screwed on while simultaneously being pressed against the support. The paper is thus pressed

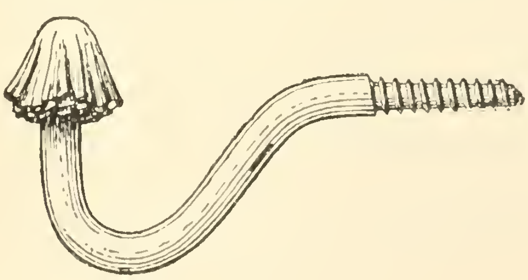


Fig. 2.

together, so that it quite fills the space between the support and the inner threaded part of the insulator, as is illustrated in Fig. 3, where the support with the insulating caps is shown after the insulator has been first fastened on and then screwed off. The number of caps which is required is ascertained by trial for each special kind of insulator and support. The thickness of the paper is preferably so chosen that four to five caps have to be used for each insulator.

It will improve the insulation if, before the insulator is screwed on there is put inside the same some drops of an oil which will not become rancid, such as paraffin oil, which can, if desired, be mixed with raw linseed oil. For this purpose a small oil can can be used.

The particular advantage of the insulating caps is the greatly improved insulation. This increase in insulation is due to a great extent to the fact that the space between the support and the inner mantel of the insulator is always free from filaments and the like, in contrast to the state of things when black oakum is used.

Another cause of the improved insulation is that the insulating caps cover the support not only at the side but also at the top with a water-tight insulating mass. Thus a crack in the upper part of the insulator does little or no harm. A large number of experiments have also proved that the insulator can be broken off at the top, so that the hole for the support becomes visible without the insulation being affected in any noticeable degree, at least for some length of time. This fact is of the greatest importance in all places where the insulators are exposed to damage, and also in places where, for instance, insulators which have not been separately tested are

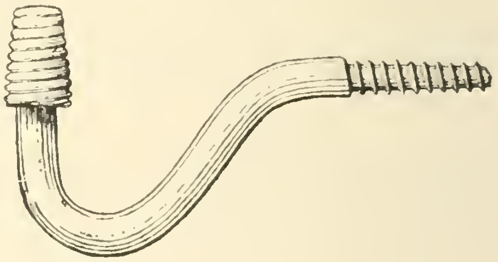


Fig. 3.

used for the support of low tension current conductors, as among such insulators there are not a few which have fine cracks extending through the same and causing leakage of current in bad weather.

A third and very essential cause of the improved insulation which is obtained by the use of insulating caps is that they are impregnated with an oily insulting material, whereby the insulators are made to act as oil insulators. The oily, creased surface of the lowest part of the caps, between the support and the insulator, offers a very great resistance to surface leakage, and as this surface is the best protected part within the insulator, it can keep clean and act for a long period. It is clear, however, that, by degrees, the oil will get dirty by dust, etc., and that the insulation will diminish. But, for the reasons mentioned above, the insulation will always be greater than if black oakum is used, and it can easily again be increased by unscrewing the insulator and putting on new caps, or, if desired, by again soaking the old ones in oil. This would be a most advantageous method of proceeding, especially in the case of important low tension conductors, as, for example, long telephone lines.

A well-known cause which contributes to the deter-

*Translated from the Teknisk Tidskrift.

ioration of insulation, always noticed on old conducting lines, is that spiders and other insects frequent the places on the underside of the insulators between the mantels and the support. This inconvenience can to some extent be remedied, where insulating caps are employed, by adding birch oil or some other substance the odor of which is avoided by insects to the material with which the caps are impregnated. This has, however, not been tested in practice.

Insulating caps have also other advantages besides the increase in insulation, and the first thing to be noticed is that the mounting of the insulators is greatly facilitated. Experiments have proved that, when insulating caps are used, the mounting takes only half the time which is required when black oakum is used, while little or no practice is needed to do the work.

In addition to this, insulators with insulating caps will always be mounted concentrically in respect to the support, for the reason that the material in the caps automatically spreads itself equally round the support when the insulators are screwed on.

Experience has also proved that breakage of insulators, when these are being mounted, seldom or never occurs when insulating caps are used, which is of considerable importance.

Finally, it should be mentioned that the unscrew-

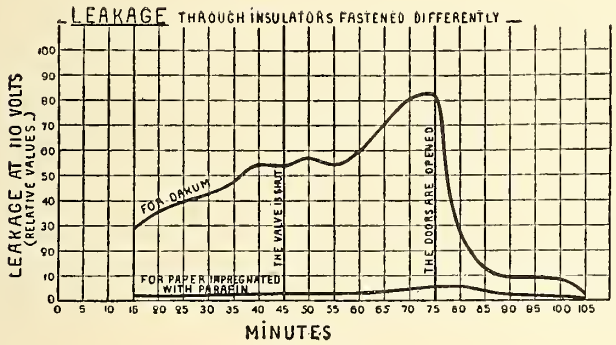


FIG. 4.

ing of the insulators from the supports is considerably facilitated by this new method of mounting the same, a fact of great importance on lines where the insulators are much exposed to soot and smoke, and must consequently often be taken down to be cleaned.

In order to show in what degree insulating caps affect the insulation, a diagram (Fig. 4) is reproduced, showing tests carried out by the Material Testing Department of the Royal Technical College, to show the difference between insulators fastened with oakum and some insulators fastened with insulator caps.

The tests were made in a rain-chamber, and the diagram shows the leakage, partly during the rain, partly for a time after the rain had ceased. From the curves shown it will be seen that the paper fastenings gave when the leakage was highest more than ten times as good a result as the oakum fastenings.—The Electrician.

ELECTRIC PUMPING.

Electrically-driven turbine pumps were the subject of discussion at one of the sessions of the American Waterworks Association, which convened in Toronto last month. The paper of Mr. Henry L. Lyon, Deputy Water Commissioner of Buffalo, contended that the cost per million gallons of water pumped by electrically-driven engines was $4.84, while the steam-driven pumps required $5.22 per million gallons.

As a general proposition this was disputed by Messrs. Will J. Sando, consulting engineer, Milwaukee; Chas. A. Hague, consulting engineer, New York, and D. W. French, superintendent, Weekawken, N.J. It was claimed that the proximity of Buffalo to the Falls, and the consequent cheapness of electrical power there, weakened the argument in favor of the electrical pumps. In Boston, where coal costs $3.87 a ton, as against $2.50 in Buffalo, equalizing the head pumped against, the price of pumping was only $4 as against $5.22 in Buffalo. Seven municipal and fifteen individual steam pumping stations in the United States pump water cheaper than Buffalo, notwithstanding the favorable conditions existing at Buffalo.

The world's record for economy and efficiency of waterworks pumping engines is held by the plant at Bissell's Point, St. Louis, Mo., built by Allis-Chalmers Company of Milwaukee. The duty reached at the official test was 181,068,605 foot pounds. In order that engineers may know exactly how these figures were reached the company printed in bulletin form complete details of the test. These and other bulletins containing information not usually made public but of great value to those interested in waterworks were distributed among the members of the American Waterworks Association by Allis-Chalmers-Bullock, Limited, in a handsome souvenir cover.

The experience of the city of Montreal in the matter of electric pumping was given to the American Waterworks Association in a bulletin by the John McDougall Caledonian Iron Works Company, Limited, containing a report of the official test on the three stage 14 inch Worthington pump driven by a 400 horse-power Allis-Chalmers-Bullock induction motor installed by them at the McTavish street pumping station.

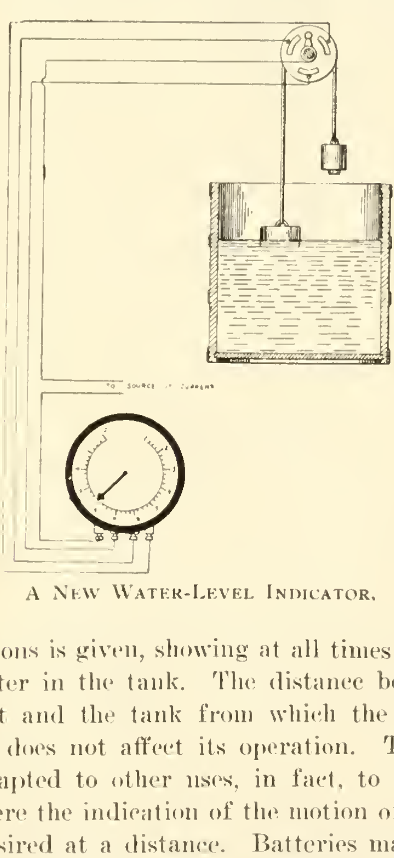
STARTING ARRANGEMENTS FOR GAS ENGINES.

For gas engines of 100 brake horse-power and upwards, the starting arrangements should be most carefully considered if a proper degree of certainty in starting is to be secured. In such sizes there are two chief methods employed, namely, where an initial charge of explosive mixture is pumped into the cylinder and then ignited to obtain the first impulse, and the alternative to this is to provide a supply of compressed air for putting the engine in motion, after which it automatically draws in the first charge in the usual way. In both cases it is customary to fit either a friction clutch or a fast and loose pulley to the main drive from the engine, so that it may start free from external resistance. In view of sizes of the belts involved, which are unwieldly for shifting from fast to loose pulleys, and of the frequent application of rope drives, friction clutches are being increasingly employed, and a word of warning in respect of them will not be out of place. There are good clutches and bad clutches, and of the latter it may be said that there is no appliance which will cause more worry and trouble than a bad clutch. It is almost superfluous to add, therefore, that only the best clutch should be considered for the purpose and in ordering purchasers should state clearly for what purpose the clutch is intended, and that it must be amply strong for the work. On the whole, we would be inclined to advocate the invariable adoption of compressed air as a starting medium for engines of 150 horse-power and over, but the use of petrol as a means of supplying a powerful gas to the engine for starting purposes is also being increasingly employed with exceedingly good results.—Journal of Electricity, Power and Gas.

INVENTION and DEVELOPMENT

IN THE ELECTRICAL FIELD

New Water-level Indicator.—A simple water-level indicator, developed by A. A. Radtke, of Chicago, has recently made its appearance. It is an electrical device, and can be installed by anyone having a little electrical knowledge. The apparatus at the tank, as shown by the accompanying diagram, consists of a small drum carrying two cords, one attached to a float and the other to a counterweight. At one end of the drum is a brush contact, which successively passes over three fixed contact plates when the drum rotates. Four wires serve to connect the contact drum with the instrument. The indicator is so constructed that it can be attached to any lighting circuit. The current required is one-quarter ampere. The feature of this indicator is that a complete series



A New Water-Level Indicator.

of indications is given, showing at all times the height of the water in the tank. The distance between the instrument and the tank from which the indication is desired does not affect its operation. This device is also adapted to other uses, in fact, to any application where the indication of the motion of a moving part is desired at a distance. Batteries may be used to furnish the current when a lighting circuit is not available.

Electric Scintillator.—It is proposed to illuminate the falls of Niagara by the electric scintillator, an effective display illuminating device recently invented by W. D'A. Ryan, the well-known illuminating engineer of Lynn, Mass. The apparatus was designed by Mr. Ryan partly as a new feature of the Jamestown Exposition, but for financial and other reasons it was decided not to use it. The practicability of the device and its capability to produce exceptionally striking illuminating effects were, however, demonstrated in a 54-night consecutive run at Bass Point, Nahant. The apparatus proposed for use at Niagara Falls will differ materially from the scintillators above referred to, particularly in its size and application. Mr. Ryan proposes to use two batteries, one of five 60 inch projectors mounted at the highest available point on the Canadian side and so placed as to catch the crest of the falls and plunge the light into the broken water as it rushes down between the bridge and the brink on the American side. These will be so placed that they can be used to advantage to sweep the rapids and the Canadian Falls. The color attachments will be used so as to tinge the water various shades, including carmine, crimson, orange, yellow, green, violet and purple of the purest shades obtainable. These various shades will be combined in different ways so as to introduce innumerable pleasing tints and shades in various combinations.

The second battery will consist of twenty-five 36 inch projectors mounted in the form of a crescent at the base of the Gorge on the Canadian side. These will also be provided with color attachments and the projectors will be so placed that they can be concentrated on either the American or Canadian Falls, or sub-divided so as to cover the Canadian and American Falls as well as the Maid of the Mist Falls.

Along the edge of the water opposite the battery in the Gorge the scintillator head could be installed and also the mortars for discharging the smoke bombs and mines.

The illumination without special features would consist merely of throwing white light on to the Falls without attempting any spectacular effects. Special features of twelve distinct varieties are said to be possible with Mr. Ryan's device.

Preparation of Tungsten Filaments.—A German syndicate has recently patented a process of heating tungsten almost to its melting point as a preliminary process of lamp making. The heating is effected on the formed filaments and by electricity. This is done by connecting up the filament to be treated in the same manner as an ordinary incandescent lamp filament, either in vacuo or in an indifferent gas, and heating the same to a very high degree by means of the electric current; or the filament may be heated in an electric arc generated between tungsten electrodes. The tungsten incandescent body to be employed should, in the preliminary process, be heated to a degree corresponding to at least 1 watt per candle-power This intense heating will in a short time render the filament sufficiently constant for practical purposes for a consumption of from 1 to 1.5 watts per candle-power. The advantageous effect which has been found to follow this heating is stated to be probably due to the fact that the filament gives off all of its impurities in the high temperature and becomes denser. It is stated that if an osmium filament is heated considerably above the usual temperature, it becomes so ductile that it can be easily rolled to a spiral without breaking, but at the same time its electrical resistance falls to a most extraordinary extent; on the other hand, the effect of this high degree of heating on tungsten produces no alteration whatever in its physical properties.

CHOKE-COILS VERSUS EXTRA INSULATION ON THE END-WINDINGS OF TRANSFORMERS.*

By S. M. Kintner.

Surges along a transmission line are stopped and thrown back by choke coils in a manner analogous to the reflection of water waves by a breakwater at the entrance to a harbor. The quiet of a harbor is obtained by setting up a strong wall capable of withstanding the shock of the waves that strike against it; so is the analogous quiet of a transformer obtained by placing a choke coil in the path of a disturbance.

A choke coil will be effective in reflecting and shielding all back of it according to its strength. The strength of a choke coil is measured by its inductance and its insulation. If the former is small, but little reflection will take place, the surge passing through the coil and continuing beyond it. If the insulation of the coil is weak and the inductance is of sufficient value to retard the on-coming wave and throw it back on to the line, the rise of voltage will cause a discharge over the coil face and the wave will continue to pass the coil. These two conditions can be likened to a breakwater consisting of piling spaced so as to have little effect in retarding an incoming wave in the first instance; and in the second instance to a breakwater of insufficient height so that the waves pass over it.

With a given choke coil on a given line, a certain fixed amount of protection will be afforded any apparatus placed back of the coil. There is no relation between the coil and the apparatus being protected that will make the coil more or less effective in its operation of throwing back surges that come in from the line. The choke coil will produce the same percentage of reflection regardless of what it is protecting, and consequently can be said to be affording the same protection.

Tests indicate that the same percentage of protection will be afforded by the same coil for all parts of the same transformer; that is, measurements made over 200 turns of the winding of a transformer which was being subjected to static surges from a discharging condenser: first, when the transformer was unprotected; secondly, when it was protected by a choke coil, showed practically the same percentage of protection afforded by the choke coil when the measurements were repeated over only twenty turns of the transformer. A long series of tests, the results of a part of which have been recently made known to the Institute by Mr. R. P. Jackson, have convinced the writer of the truth of the above statements.

In choosing a choke coil for a particular installation, the matter resolves itself into a consideration of: 1, the possible surge the apparatus can withstand safely; 2, the probable surge that can be transmitted over the proposed line, the line insulation indicating the maximum voltage that the surge can have during transmission; 3, the maximum allowable inductance that will not seriously affect the line regulation if an external choke coil is used; 4, a consideration of the amount of money to be expended for choke coils as insurance against interruption; 5, the selection of a choke coil which will most nearly meet the above conditions, the selection being guided by the above, combined with the results of tests and curves similar to those shown in Mr. Jackson's paper.

The question of whether part of the transformer winding should be made strong enough to withstand the surges—and thus have within its own windings a choke coil that protects the rest of the apparatus—or whether an extra coil should be used, will be discussed below.

The following is a list of the advantages of separate choke coils:

Advantages.

1. On a choke coil there is normally no voltage between turns, and consequently no tendency to hold a short circuit in the event of a momentary surface discharge.

2. The choke coil permits the construction of a transformer with uniform insulation throughout. This permits the safe working of such a transformer with several methods of connection to the line.

3. The choke coil allows the safe use of a cheaper transformer.

4. The choke coil can be insulated much more strongly than a transformer.

Disadvantages.

5. Increase in the number of pieces of apparatus.

6. Increase in complication of station wiring when external choke coils are used.

1. One of the greatest advantages of choke coils over extra insulation on the transformer windings lies in the fact that the choke coil does not normally have a voltage between turns. In the event of a choke coil insulation failing between turns, nothing in the nature of a short circuit results, as there is no voltage difference to maintain an arc. On the other hand, a failure between turns in the insulation of a transformer is vital, and it is almost certain to result in a transformer burn-out. A part of the choke coil will be cut out and will be inoperative, and consequently the coil less effective as a whole is the worst that can result from such a failure in the coil insulation.

2. The second point of superiority of the choke coil—allowing the use of a transformer which is uniformly insulated—is of great advantage to the builder, as well as to the operator.

In the majority of specifications for power transmission transformers, it is required that the transformer be capable of operating at one-half voltage at full rated capacity. In general, it is expected also that occasion may arise when the transformer may be operated either in star or delta connection.

It is evident that to meet all the above conditions with certain parts of the transformer specially insulated, involves some very complicated insulation arrangements, and requires extra insulation on a large part of the whole transformer.

3. In consideration of the third point, that of cost of transformer, it should be remembered that the better grade of power transmission transformers of 1,000 kw. and upward are wound with copper ribbon, one turn per layer. These coils are insulated uniformly throughout, so as to stand momentary voltages of from 5,000 to 9,000, between turns. In order to get this result, only about 8 to 10 per cent. of the available winding space can be used for copper, the rest being given up to solid insulation and oil ventilating ducts. An increase in insulation over the above is not desirable with the insulating materials in use at this time for two reasons: first, the coils cannot be made strong enough mechanically to stay in place under the shocks to which they are subjected; secondly, the extra insulation retains the heat from the copper, and thus either burns out or necessitates a much lower rating of the transformer.

It is very difficult for workmen to handle large coils with extra heavy insulation without injury to the insulation.

It is therefore evident that a cheaper transformer can be employed when a protecting choke coil is used.

4. The fourth advantage of the choke coil is that much better insulation can be obtained in it than in a transformer. This is due to the fact that more material can be used by allowing more extension beyond the copper than could be employed economically in a transformer coil; also the shape of the coil is much simpler than that of the average transformer coil and thus more readily lends itself to better insulation.

5-6. The disadvantages of the choke coil over the extra insulation are two in number; first, an increase in the number of pieces of apparatus; secondly, an increased complication in the station wiring when an external choke coil is used. Both of these disadvantages are very materially reduced when it is permissible to mount the choke coils inside of the transformer tank. It is thus possible to make the choke coil a part of the transformer terminal, the coil being connected on the inner end of the terminal.

For some installations it is possible to use choke coils mounted out in the air and thus made a part of the station wiring, but in general the oil-insulated coil is to be preferred. Past practice has been to have each oil-insulated choke coil mounted on its own tank, but there seems to be no good reason why they cannot be placed inside the transformer tank and thus save considerable floor space as well as outside wiring.

After a thorough consideration of what is involved in the above points, it is the writer's opinion that for a given expenditure to provide protection against surges, more can be obtained by the use of choke coils than by extra insulation on the transformer.

* Paper presented at the 24th Annual Convention of the American Institute of Electrical Engineers, Niagara Falls, N.Y., June 26, 1907.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS.

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Can you tell me of any way to distinguish between incandescent lamps which have got broken and those which burn out? We quite frequently have lamps returned to us because they have burnt only a little while, though really we sometimes think that some boy has dropped them and broken them.

Answer.—Fortunately for both those making lamps and those who are handling and consuming them, there is an infallible test for a broken versus a burnt-out lamp, and that is this: If a filament be broken from dropping the lamp, or any severe jar, the ends of the filament are square right to the point of breakage, whereas if the lamp failed from burning out the ends of the filament will invariably be pointed. The difference is extremely marked, and can be detected at once by the eye, the best way to see the break being to hold the lamp in front of a sheet of white paper. In addition to this, all treated filaments turn black at the points, this blackening being very plain as compared with the steely gray color which is characteristic of a treated filament. When this effect is present it is very strong corroboration of the pointed end effect, in fact either alone is infallible, and enables one to say most positively that a lamp did or did not burn out, irrespective of any statements to the contrary. You must note that the blackening effect is not found in the very small candle power medium voltage lamps, nor in some of those made for high voltages, because the filaments in these classes are not always treated, obviously the untreated filament, being black already, cannot show a blackening effect.

Question No. 2.—Would cast iron bearing bushings be satisfactory and practical to be used on 60 cycle induction motors running at 1,800, 1,200 and 900 revolutions per minute without any fear that the bearing may get loose too soon so that the rotor will strike the stator, on account of its small air gap (.012-.025)?

Answer.—We would say that the results, as long as the equipment were given very close attention, would be quite satisfactory. On the other hand any small particles of dirt, or any slight deficiency in the oil, would be much more likely to develop serious trouble in an iron bearing than if it were made of brass or some of the standard alloys. Then again if the trouble does become serious you run far greater chances of damaging your shaft, if it be operating in an iron bearing, than if it were running in one of the other styles, because these latter metals, being softer than the shaft, are usually the parts which suffer the most, the shaft coming out comparatively undamaged. Another objection to a cast iron bearing is that it cannot be poured except from a cupola, besides which it always requires machining. As opposed to this the various babbit alloys can be melted on an ordinary forge fire, and can be fitted with comparatively little trouble. As a matter of fact a great many boxes of this type are lined by pouring direct on to the shaft or a mandrel, and used without boring, though in induction motors the allowable clearances are too small to admit this practice, unless for emergency cases. In flooded bearings, the type always used in all modern motors, the friction of iron upon iron is just about the same as that of iron upon brass or babbit, though this is not true of surfaces under steam pressure, and where in addition the lubrication is only medium, such as slide valves and piston packing rings. In such situations the friction of iron upon iron is less than that of any other combination, and the life of the parts is much greater.

Question No. 3.—What is the proper size for a neutral wire in three wire work? What sized conduit should I use for three No. 0 wires?

Answer.—For single phase or direct current three wire work the neutral theoretically need be only just large enough to carry the unbalanced load, for instance, a No. 14 would be quite sufficient to carry an unbalanced load of 5 amperes, assuming not too great a distance, even though the load on the outsides were heavy enough to require a No. 0. Practically, though, this is never done, the neutral always being made at least 5 per cent. of the two outsides. Sometimes it is made the full size, in which case one side of the system can be out entirely and the other still carry full load with normal drop. Then occasionally the neutral is made twice as large as the other two, so that by the use of a breakdown switch the whole system can be converted into a two wire plant, and the whole load carried by one side with the usual drop. In three wire two phase systems the neutral should be 140 per cent. of the two others. Three No. 0 conductors will require a 1 1-2 inch conduit, but they should be cable, not wire.

Question No. 4.—What are the advantages of single phase motors in comparison with the polyphase form? What is the largest size that it is desirable to install, and what is the largest size made?

Answer.—We presume that you are speaking of a polyphase plant, because if the plant be single phase the advantages of course are manifest, namely, that they allow you to give a power service, in medium sized units, off a plant that otherwise is incapable of doing anything but lighting. For polyphase plants the main advantage is that you do not have to extend your three wires wherever power is needed, the two already installed for lighting being as a rule quite sufficient. In addition to this saving you have the decreased cost of transformers and secondary wiring, though these will be partially offset by the increased cost of the motor. The largest size desirable is more a matter of plant capacity than of the motor itself, 5 horse-power being perhaps a very fair limit for all medium sized generating stations. Sometimes this is extended to include as high as 15 horse-power, though motors of this size are inclined to produce too much unbalancing unless the plant be fairly large. We understand that the largest size that has been made is about 60 horse-power, though these of course are more or less rare. Motors of 30 and 35 horse-power are in constant use in some of the larger United States plants.

ALTERNATING-CURRENT ELECTROLYSIS.*

By J. L. R. Hayden.

Summary.—The author gives results of electrolytic experiments carried out with different metals in various salt solutions at frequencies of 60 and 25, and with direct current. Some of the experiments were repeated with these solutions in different soils. Lead is generally attacked more than iron, and the results vary considerably with the different salts. The corrosion is found to be reduced to a negligible amount by superimposing on the alternating current a direct current equal to 1.5 per cent. of the alternating current.

The development of the one phase railway motor and the introduction of grounded alternating current systems, in which the current is returned along the rails lead to some difficulty in protecting lead cables, etc., from electrolytic corrosion. An investigation was therefore undertaken to determine whether, and to what extent, alternating currents passing between any metallic conductor and the ground would produce electrolytic corrosion. These tests were started in the spring of 1906 and carried on practically continuously throughout most of the year, being extended to the investigation of different current densities and different frequencies. First, several series of tests were made with diluted solutions of such salts as may be expected in the ground. Then different kinds of soils were investigated, and then tests made on a typical soil by adding different substances—carbonates, sulphates, organic matter, etc.—and noting their effects. Ultimately the possibility of protection against electrolytic corrosion was investigated.

In the first set of tests lead and sheet iron were investigated; in the last tests only lead plates were used, as the first tests proved the relative unimportance of iron.

Method of Test.—Plates of 1.25 width and 2.5 in. height were used—that is, with about 6.25 sq. in. exposed area of very thin and pure sheet lead, so-called "test lead." These plates, after cleaning, were weighed on a chemical balance, reading accurately to about 0.5 milligramme, then immersed in the electrolyte or the soil, the current passed through for a time varying from 60 to 390 hours; then the plates were taken out, washed with water and dilute acetic acid (about 10 per cent.), dried, and again weighed. The total weight of each plate was about 6 grammes, and the amount dissolved usually several hundred milligrammes. Check tests showed that the amount of lead which can be dissolved chemically by acetic acid washing does not exceed 1 or 2 milligrammes. The iron plates were cut to the same size, from transformer iron of 10 milligrammes thickness, having an average weight of 2.5 grammes. They were treated in the same manner, except that very dilute hydrochloric acid was used for washing.

As containing vessels glass tumblers were used of about 250 cubic cm. volume, and the soil was kept moist by replacing the evaporation with distilled water. A number of tumblers were connected in series with an alternating current circuit and immersed in a water bath. The same number of tumblers, with similar contents but not connected to the electric circuit, were immersed in the bath, and used as a check to determine the spontaneous corrosion due to chemical action of the soil. The lighting mains of the city of Schenectady were used as the source of 60 cycle current; as the source of 25 cycle current a small inverted one phase converter changing from direct to alternating current; as the source of direct current a mercury arc rectifier operated from the 60 cycle circuit.

To give quantitative values all the results are expressed in percentages of direct current electrolysis—that is, the amount of metal dissolved per ampere hour by alternating current electrolysis is given in terms of the amount which 1 ampere hour direct current should dissolve by Faraday's law: 3.86 grammes lead and 1.035 grammes iron per ampere hour, assuming the valency of both metals as 2. In some tests, plates of one-half or one-quarter of these sizes were also used, in series with full size plates, to determine the effect of various current densities.

Tests with Salt Solutions.

One per cent. solutions in distilled water were used of those salts which may be expected in the soil.

1—1 per cent. ammonium nitrate.
2—1 per cent. ammonium carbonate.
3—0.5 per cent. sodium nitrate and 0.5 per cent. potassium nitrate.
4—0.5 per cent. sodium carbonate and 0.5 per cent. potassium carbonate.
5—0.5 per cent. sodium chloride and 0.5 per cent. potassium chloride.
6—0.5 per cent. sodium sulphate and 0.5 per cent. potassium sulphate.
7—0.25 per cent. ammonium nitrate; 0.25 per cent. ammonium carbonate; 0.125 per cent. sodium chloride, 0.125 per cent. potassium chloride; 0.125 per cent. sodium sulphate, 0.125 per cent. potassium sulphate; referred to in the following as "mixture."

Eight sets of tests were made, four with lead plates and four with iron plates, under the following conditions:—

(a)—60 cycles 0.3 ampere, or .0048 ampere per square inch.
(b)—60 cycles 0.09 ampere, or 0.0144 ampere per square inch.
(c)—25 cycles 0.3 ampere, or 0.048 ampere per square inch.
(d)—25 cycles 0.09 ampere, or 0.0144 ampere per square inch.

It is interesting to note that considerable quantities of lead were found in solution only with ammonium nitrate, and small traces of lead with sodium-potassium carbonate. No lead went into solution with the other salts. The electrolytic corrosion due to alternating current is very small compared with the electrolytic effect due to direct current, and in no case did it equal 1 per cent.; in fact it rarely exceeded 1-2 per cent. of the direct current electrolysis.

In general, then, iron is attacked less than lead. It therefore seems that, in general, with iron, alternating current electroylsis is less to be feared, except in extreme cases—that is, with large currents passing between rails and iron pipes. With lead cables the amount of corrosion would in many cases lead to a rapid destruction of the relatively thin cable sheet. The effect of alternating current on lead cables is, therefore, the more serious problem.

No general relation exists between the chemical corrosion taking place without any current and the electrical corrosion resulting from the passage of an alter-

*Abstract of a paper read before the American Institute of Electrical Engineers.

nating current. For instance, the chemical corrosion is about the same with sodium-potassium nitrate as with carbonate solutions; while the electrical corrosion is very high with nitrates and practically negligible with carbonates.

High current densities sometimes increase the electrical corrosion, as with ammonium salts; sometimes they decrease the corrosion, as with chlorides; but usually the current density has no appreciable effect.

In general, electrolytic corrosion is greater at lower frequency, but this is not always the case. For instance, with carbonates, where the electrolytic action is very low, high frequency seems to corrode more than low frequency; but with alkali nitrates, chlorides, and the mixture of salts, frequency has no appreciable effect.

In most cases the higher the quantity of electricity per alternation the greater the corrosion.

The "mixture" of different salts gives a very much lower chemical attack than the average attack of the components—that is, some salts, as the sulphates or carbonates, protect the lead against the attack by the nitrates. Electrolytically, however, the reverse is the case; this protective action of one salt against the attack by another does not seem to exist. The conclusion herefrom is that it may be possible to protect lead cables chemically against spontaneous or chemical corrosion by surrounding the cables with alkali sulphates, for instance, but this affords no appreciable protection against electrolytic action by alternating current. The data on the electrical corrosion by ammonium nitrate are not very reliable, since ammonium nitrate attacks and dissolves lead chemically so rapidly that the additional attack by the alternating current cannot be determined accurately. In all other cases the chemical corrosion is rather less than the electrical.

TABLE I.—LEAD PLATES.—ORDER OF CHEMICAL CORROSION.

	Mg. per hour.
1—Ammonium nitrate	2.18
2—Sodium-potassium nitrate	0.553
3—Sodium-potassium carbonate	0.535
4—Sodium-potassium sulphate	0.316
5—Sodium-potassium chloride	0.270
6—Mixture	0.170
7—Ammonium carbonate	0.102

Table I. gives the order in which lead is attacked chemically by the different solutions. Nitrates attack the hardest, next come the alkali carbonates, and last is ammonium carbonate, and the mixture of salts in which some salts act as a protection against the others.

In alternate current electrolysis the nitrates give the greatest corrosion, chemically as well as electrically. The other salts act electrically practically in reverse order to their action chemically; the alkali carbonates give the greatest chemical and the least electrical attack, next come the sulphates, then the chlorides.

TABLE II.—LEAD PLATES—ORDER OF TOTAL CORROSION

		Per cent. direct current electrolysis.	
	Number.	Total.	Electrical.
Ammonium nitrate and sodium-potassium nitrate	1, 2	0.650	0.397
"Mixture," and ammonium Carbonate	6, 7	0.329	0.303
Sodium-potassium chloride ...	5	0.218	0.167
Sodium-potassium sulphate ..	4	0.126	0.066
Sodium potassium carbonate	3	0.096	0

The approximate order of total corrosion of the different solutions is given in Table II. Comparing this with Table I. it is evident that, with the exception of ammonium nitrate and sodium-potassium nitrate the order of attack is reversed.

In general, decreasing frequency and increasing current density have similar effects. These effects depend very largely on the chemical constitution. Ammonium salts show a very great increase of corrosion with increasing current density, or decreasing frequency; whereas chlorides and sulphates show little effects of frequency, and a decrease of corrosion with increasing current density. In general the conclusions of the tests with lead plates in salt solutions are:

1. Chemical as well as electrical corrosion is greatest with nitrates. With other salts or mixtures of salts, the electrical corrosion is not proportional to the chemical corrosion, but, with the salts investigated, rather inversely proportional thereto—that is, where the chemical attack is considerable, the electrical action is more completely reversible than with a chemically less active electrolyte.

2. Current density in general has no decided effect. High current density increases the attack with some compounds, as ammonium salts, and decreases it with others, as chlorides and sulphates, provided the current density is not so high as to give an appreciable increase of temperature, which then increases the corrosion.

3. Low frequency usually attacks more than high frequency. But the increase of corrosion due to lower frequency entirely depends on chemical constitution, being largest with ammonium salts, and practically negligible with chlorides and sulphates.

4. Mixtures of salts frequently give a greatly reduced chemical corrosion, but give about the same or a higher electrical corrosion than their components—that is, chemical protection fails to protect electrolytically.

5. Iron is less attacked than lead, and is practically not attacked at all by carbonates.

EXPERIMENTS WITH DIFFERENT SOILS.

Tests were made with different soils.

1. Garden soil, a clay loam.

2. Street mud, collected from the surface of Schenectady's main street (State street railway crossing), where the New York Central Railroad crosses the trolley line, and thus containing the accumulated effect of foot, horse, electric and steam traffic.

3. Sub-soil, a sandy soil collected from below the street surface in the older part of Schenectady, where people lived for over 200 years, the soil containing the seepage of centuries.

4. A mixture, in equal volume, of these three soils.

The soil was kept moist by replacing evaporation with distilled water. It was considered that these three soils are about representative of the more severe conditions to which lead pipes and cables in the soil are exposed. Four sets of tests were made, of lead plates, and of iron plates, with 60 cycles and with 25 cycles, all at 1-10 ampere current. The same size of plate was used as before and tested in the same manner.

The effect of frequency is very marked. While at 60 cycles the electrical corrosion is very small, averaging less than 0.05 per cent. with lead plates, it is quite considerable at 25 cycles, averaging 0.222 per

cent. The chemical corrosion of lead plates averages 0.148 milligramme per hour, with 6.25 sq. in. plate surface. The total corrosion averages 0.085 per cent. at 60 cycles, and 0.216 at 25 cycles, and the electrical corrosion averages 0.047 per cent. at 60 cycles and 0.22 per cent. at 25 cycles of the direct current electrolysis. Especially marked is the enormous increase of corrosion with increase of temperature, which is investigated later.

Since only small differences were found for different soils as compared with different salt solutions, it was thought sufficient in the further investigations to use only one form of soil as typical—the mixture referred to above—but to investigate the effect of the addition of different substances.

Salt Solutions in the Soil.—Tests were therefore made by moistening the soil, not as before with distilled water, but with very diluted solutions of nitrates, and nitrites, carbonates, sulphates, and their mixtures, to determine whether the presence of nitrates increases the corrosion, and the presence of carbonates exerts a protective action. These experiments were made only at 25 cycles, 0.1 ampere, with the same size of lead and iron plates of 6.25 sq. in. total surface. The solutions used included Schenectady city water, 0.1 per cent. K_2CO_3 + 0.1 per cent. Na_2CO_3, 0.1 per cent. K_2SO_4 + 0.1 per cent. Na_2SO_4, and mixtures of the nitrates, nitrites, carbonates and sulphates of sodium, potassium and ammonium. The results were apt to be erratic.

In one test nitrates and nitrites exerted a marked protective action on iron plates, which, however, disappeared in the presence of carbonates. In another test nitrates and nitrites greatly increased the corrosion of iron plates. This may have something to do with the possibility of a passive state of the iron, and needs further investigation.

Carbonates exert a marked protective action on lead plates, which is reduced if nitrates and nitrites are present; even then it is considerable. Sulphates also exert a protective effect on lead plates, but this protective action disappears and the corrosion is increased in the presence of nitrates and nitrites. This agrees with previous experience in the tests with salt solutions. With iron plates sulphates increase the corrosion.

It seems, then, that a certain protective action against alternating current electroysis of lead plates is exerted by carbonates and by sulphates. Since alkali salts are excluded from practical use by their solubility, a series of tests were undertaken to determine the effect that calcium carbonate and sulphate —chalk and gypsum—have on alternating current electrolytic corrosion, when mixing these salts with the soil surrounding the lead cables.

Calcium Salts in Soil.—Tests were made on the effect produced by mixing 5 per cent. chalk or 5 per cent. gypsum, or both, with the soil used in alternating current electrolysis. Some tests were also made by adding 5 per cent. Portland cement, and by adding 5 per cent. fertilizer containing nitrates, phosphates and ammonium compounds. Only lead plates were used, of the standard size of 1.25 in. by 2.25 in., with a current of 0.1 ampere.

Tests were made at 60 cycles, as well as at 25 cycles, to determine the effect of frequency.

Tests were made with the mixed soil, and also with the same soil by adding 5 per cent. chalk, 5 per cent. gypsum, 5 per cent. Portland cement, 5 per cent. fertilizer, containing nitrates, phosphates, ammonia, 5 per cent. fertilizer, 5 per cent. chalk and 5 per cent. gypsum. City water was used as liquid, except in a few tests, in which 0.5 per cent. salt solution was used of the following constitution: Ammonium nitrate 2, potassium nitrite 1, sodium nitrite 1, potassium chloride 1, sodium chloride 1, water 1,194. Each tumbler contained about 120 cubic cm. of liquid, in addition to the soil.

The addition of chalk and gypsum to the soil exerts a marked protective action, which, however, practically disappears when a mixed salt solution is used instead of water. Gypsum exerts a marked protective action only at 60 cycles, but increases the corrosion at 25 cycles. Addition of chalk, as well as gypsum, gives the same effect as gypsum—a reduction of the corrosion at 60 cycles, but an increase at 25 cycles.

Organic materials, as fertilizer, greatly increase the electrolytic corrosion, and the addition of chalk and gypsum in this case still further increases the corrosion.

The effect of Portland cement is interesting; while the chemical corrosion is greatly increased by cement, from 0.159 to 0.247 milligrammes per hour, the electrolytic corrosion is greatly reduced and becomes very small at either frequency.

The current density seems to have very little, if any, effect, since half size plates, with the same current, give practiaclly the same corrosion as full size plates.

Especially interesting is the effect of frequency. In general, at lower frequency the corrosion is greater; but the order in which it varies with the frequency very largely depends on the chemical character of the soil. With soil only, the corrosion increases with decreasing frequency, but not anywhere near inversely proportional to the frequency. The addition of chalk or fertilizer seems slightly to increase the effect of frequency, but not to any great extent. Gypsum very greatly increases it, so that 60 cycle electrolysis nearly disappears, and the 25 cycle electrolysis is more than six times the 60 cycles electrolysis. Inversely, cement reduces the effect of frequency, so that both frequencies give practically the same attack.

It is worth noting the high values of electrolytic corrosion observed in soils containing fertilizer, especially when chalk and gypsum are added. These reach nearly 1 per cent. of direct current corrosion at 25 cycles and exceed 1-2 per cent. at 60 cycles.

Conclusions.—The presence of nitrates, fertilizers, etc., in the soil is objectionable. Carbonates and alkaline compounds, as far as observed, always reduce the electrolytic corrosion of lead, and also the chemical corrosion; that is, they exert a protective action. This is most pronounced with alkali carbonates and cement, the latter, however, greatly increasing the chemical corrosion.

The protective action of carbonates seems to decrease in the presence of sulphates, nitrates, etc., and is in general not sufficiently large to give promise of a method of chemically protecting lead plates against alternating current electrolysis, by surrounding them with calcium carbonate or hydrate. Sulphates sometimes exert a protecting action, but some-

times increase the corrosion. The latter seems to be the case in the presence of nitrates.

Tests made with soil only, without additional protective or destructive compounds, give an average spontaneous or chemical corrosion of 0.117 milligramme per hour, or 0.0188 milligramme per hour and square inch plate surface, and an average total corrosion, at 25 cycles, of 0.312 per cent., or an electrical corrosion of 0.280 per cent. of direct current electrolysis.

Assuming the specific gravity of lead as 11.4, under these conditions, by chemical corrosion, in 10 years a layer of lead of 0.009 in. thick would be consumed—that is, under average conditions, chemical corrosion of lead cables could be neglected.

Electrically ,at a current density of 1 ampere per square foot, 25 cycles would, in 10 years, destroy an additional layer of lead 0.07 in. thick. In the worst case observed this would increase to 0.22 in., or nearly 0.25 in.—that is, would eat through the cable armour long before this time.

With a current density of 10 amperes per square foot, a cable armour 1-8 in. thick would on an average be eaten through in 1.8 years, but in the extreme case may be eaten through in 0.57 year, or seven months.

Effect of Temperature.

Since, in the preceding tests, especially in the first set of tests, before a water bath was used, it was noticed that the values of alternating current electrolytic corrosion were high, whenever the temperature of the cell is increased by its I^2R loss, some tests were made on the effect of temperature by heating the water bath in which the cells were immersed. The temperature of the bath fluctuated between 36 degrees C. and 42 degrees C. with an average of 39.5 degrees C.

Tests were made with mixed soil, and with mixed soil and 5 per cent. fertilizer added, at 0.1 ampere, 25 cycles, and without current. These experiments showed that the chemical as well as the electrolytic corrosion is very greatly increased by the increase of temperature.

Conclusions.

The following conclusions seem to be warranted:—

1. Alternating current electrolysis is not a phenomenon like direct current electrolysis, on which definite quantitative general laws can be formulated, but is of the character of a secondary effect—that is, the action of the positive half wave is not quite reversed by the action of the negative half wave, leaving a small difference, rarely exceeding 1-2 per cent., of the electrolytic action of an equal direct current.

Under the conditions of the investigation, which were chosen to represent as nearly as possible actual service conditions of lead cables, alternating current electrolysis varies from practically nothing to somewhat less than 1 per cent. of direct current electrolysis. Since electrolytic action of the alternating current appears as a small difference between two large and nearly equal quantities, the action of the positive and of the negative half wave, a very small variation in the action of either half wave makes a very large difference in the result, and this probably accounts for the very large variation in the electrolytic action of alternating current compared with the constancy of the electrolytic action of direct current.

2. Alternating current electrolysis, when expressed quantitatively or in per cent., of the action of an equal direct current, varies very greatly with the chemical character of the electrolyte. The nitrates and similar compounds, as fertilizers, tend to increase electrolytic corrosion; carbonates and, in general, alkaline reaction of the soil decreases the corrosion—that is, exert a protective action. This protective action against alternating current electrolysis is decreased by the presence of nitrates, etc., and is hardly sufficient to be of practical use for protecting lead cables against attack by alternating current.

3. In general, lead is more attacked than iron, and the latter shows still more erratic behaviour than lead, probably due to the existence of a passive state.

4. Alternating current electroylsis, under conditions representing as nearly as seems feasible the conditions of lead cables in the soil, does not appreciably depend upon the current density, but is practically independent thereof, except indirectly, in that very high current densities may, by an increase of temperature, give an increased corrosion.

5. In general, electrolytic corrosion by alternating currents increases with decrease of frequency. This increase with decreasing frequency does not follow a general law, but depends largely upon the chemical character of the electrolyte. It may be enormous—that is, 25 cycle current gives many times greater corrosion than the same current at 60 cycles. Or it may be very small and negligible. In some instances 60 cycle current seems to give a somewhat greater attack than 25 cycle current.

In general, ammonium salts and nitrates seem to give a very great increase of electrolytic corrosion with decreasing frequency, while carbonates and soils with alkaline reaction, as containing cement, may give little or no increase of corrosion with decreasing frequency.

6. Chemical corrosion by the soil, and electrolytic corrosion by alternating current, increases very greatly with increasing temperature of the soil.

Electrical Protection.

Since the attempt to find a method of protecting lead chemically against alternating current corrosion by mixing compounds as chalk, etc., with the soil surrounding the lead cable did not seem very hopeful, an investigation was made on the possibility of electrical protection against alternating current electrolysis. In these tests a piece of sheet zinc of about half the size of the lead plates was connected electrically with one of the lead plates. The idea was that a local action between lead and zinc would produce a direct current between lead and zinc, with the lead as negative, and thus exert a protective action.

The zinc plate was found to give effective protection. At 25 cycles the unprotected lead plate gives 0.623 per cent., at 60 cycles 0.28 per cent., of the electrolytic attack of a corresponding direct current, while the lead plate in contact with the zinc plate is practically completely protected—that is, is attacked practically no more than it would without any current, by the chemical action of the soil.

To investigate this action still further, a series of tests was made in which a small direct current was

superimposed upon the alternating current. A transformer was interposed between the inverted converter giving the 25 cycle alternating current, and the electrolytic cells, to separate the alternating current circuit electrically from the direct current circuit, and a small direct current sent through the cells in a divided circuit.

The 25 cycle alternating current consisted of 0.1 ampere; 0.005 ampere direct current was used, divided so that some of the cells received 1.14 milliamperes, while the others received 3.86 milliamperes, and the undivided direct current of 5 milliamperes passed through some cells without alternating current. Resistances were inserted in both the alternating current and the direct current circuit, and a very high reactance of about x=50,000 ohms in the direct current circuit.

The same kind of mixed soil as in the former tests was used as an electrolyte, and also this soil mixed with 5 per cent. Portland cement, and this soil mixed with 5 per cent. fertilizer. City water was used as liquid. In some tests, half size and quarter size plates were used to get the effect of current density.

The results are extremely interesting. In many of these tests the electrical corrosion was negative; the total corrosion was less than the chemical corrosion; or in other words, if upon the alternating current a very small direct current is superimposed the total corrosion of the lead is reduced below the value which would exist with no current at all flowing.

With a direct current equal to 3.86 per cent. of the alternating current added thereto, the protection is complete—that is, in every case the lead is attacked less, sometimes less than half as much as it would be attacked spontaneously by the chemical action of the soil. Even with a direct current of only 1.14 per cent., or about one-ninetieth of the value of the alternating current, the protection is practically complete, and the additional corrosion due to the alternating current is small compared with the chemical attack, or even negative—that is, the total attack is decreased.

This protection by a small direct current is especially effective under those conditions of the soil, where the electrolytic or chemical attack is especially great. With fertilizers, or with cement in the soil, a direct current of one-ninetieth the value of the alternating current reduces the corrosion below the value which it would have without any electrolytic action.

There does not seem to be a definite variation of the attack by alternate current with the current density. The corrosion of lead by direct current is greater than the theoretical value, and the direct current does not only dissolve the theoretical amount of lead, according to Faraday's law, but also increases the spontaneous corrosion due to the chemical action of the soil, especially in the presence of nitrates, etc.

Regarding the protective action of a small direct current against alternating current electrolysis, it must be understood that this is not due to maintaining the lead negative against the ground. It seems that a very small increase of the negative half wave over the positive half wave of the current is sufficient to make the negative half wave completely reverse and thus neutralize the action of the preceding positive half wave.

Other experiments showed that a direct current superimposed on the alternating current and equal to 1.5 per cent. of the alternating current, perfectly protects the lead plates against electrolytic attack by 25 cycle current; so that the corrosion of the lead plates in the soil is reduced to the value of corrosion which would take place spontaneously by the chemical action of the soil, or even less.

MAGNITITE LAMPS FOR STREET LIGHTING.

In a supplement to his report on the cost of constructing and maintaining a municipal light plant submitted to the Board of Works, Newark, N.J., Mr. Frederick O. Runyon gives the following data.

By means of numerous tables, Mr. Runyon demonstrates that the averoge cost per arc light with the "magnetite" lamp in use, and services from a municipal plant for a ten year period would be $59.67, as against $65.22, the estimate with the present type of lamps, and $70, the rate offered by the Public Service Corporation.

While increasing the item of overhead construction greatly, the report shows that the adoption of the new lamp will have the effect of reducing the capacity of the plant required 47 per cent., decrease the amount of coal necessary to approximately the same extent, and to make the labor required less. Besides increasing the cost of the outside plant, the introduction of the lamps would also have the effect of adding to the money necessary to pay for renewals.

Mr. Runyon estimates the cost of a plant at the old Belleville pumping station at $821,000, as compared with $832,650, the cost as contained in Mr. Runyon's report submitted October 8th. In the items that go to make up this total the cost of power station and stack is reduced from $225,000 to $180,000; the estimated cost of boilers, stokers, economizer and steam fitting from $118,000 to $90,000; turbo-generators from $98,000 to $84,000.

With the new lamp, overhead construction charges will cost $167,000 as against $96,000, the original figures. The cost of switchboard and electrical apparatus is increased from $17,000 to $22,000. The cost of a plant at Belleville, exclusive of engineer's fees, is $782,000, as compared with the old estimate of $793,000.

Mr. Runyon says the cost of boilers, economizers and steam fitting is reduced because the magnetite lamp does not require the conversion of so much energy as the ordinary lamp. The cost of the power station and stack is less because they will be smaller than originally contemplated, while the outlay needed for switchboards and other electrical apparatus is lower because of the additional equipment of rectifier panels.

The cost of overhead construction is increased by an amount equivalent to the difference between the cost of "magnetite" lamps and the ordinary lamp. The latter type take 7.5 amperes at 80 volts as against 4 amperes at 80 volts consumed by the new lamp, which cost about $50 apiece. The present arc lights cost $18 apiece.—Municipal Engineering.

Electric Railway Department

A COMPOSITE TELEGRAPH AND TELEPHONE SYSTEM FOR DISPATCHING ON AN INTERURBAN LINE.

By E. R. Cunningham.

The Interurban Railway of Des Moines, Ia., has worked out for itself a "Composite" telegraph and telephone system which differs very materially from any other in general use, and which has many features to recommend it, especially for interurban dispatching lines. The following description may be of interest to those who have occasion to operate dispatching lines under similar conditions.

The line as originally installed was intended for the telephone dispatching line, to dispatch the cars on the Beaver Valley Division of the Interurban Railway, and consisted of two No. 9 BB. galvanized iron wires from Des Moines to Moran Junction, where the line branched. The branch line ran 4 miles to Woodward and the main line ran 12 miles to Perry. The Perry end of the main line was 36 miles from Des Moines, and the Woodward end of the branch line was 28 miles from Des Moines. The telephone line was carried on standard cross arms on the same pole and below the high tension transmission line and was transposed every ten poles by means of a special transposition pin and insulator designed especially for this use. The telephones used on this line were of standard make and bridged on to the line in the usual manner, one being used at each station and passing point on the line.

In all there are 14 telephones bridged on to the line. The dispatching switchboard is located at the Des Moines end of the line and is a 50 line central energy switchboard with ten lines now wired up; one of which is the Beaver Valley dispatching line. Besides being used for dispatching purposes this line was also used for transmitting messages arising from freight, express, passenger and other departmental business, and it was found necessary either to build another telephone line for the commercial, or equip the existing line with telegraph instruments, making a dual use of the one line. The latter plan was found to be much the cheaper, as it necessitated but a nominal expense for the telegraph instruments, and was adopted not only because it was cheaper, but because it was thought to give a more extended and reliable service than two separate telephone lines. It was quite natural, in adopting the telegraph system to be used on this line, to fall into the well-beaten path of American telegraph practice of connecting the telegraph instruments in series. To do this, however, necessitated the use of at least eight condensers cut in the telephone line.

Fig. 2 illustrates the usual method of connecting telegraph instruments in series on a composite telephone and telegraph line. Since both sides of the telephone line are used as one side of the telegraph line it is necessary, at each intermediate telegraph station, to cut in a condenser in each side of the telephone line in order to open the line to the DC telegraph current and cause it to flow through the telegraph key and relay.

In using the telephone it is necessary to signal and

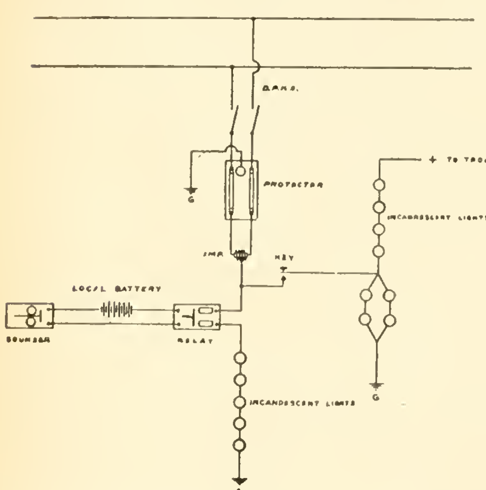


Fig. 1. Telegraph Instruments in Multiple (All Stations Alike)

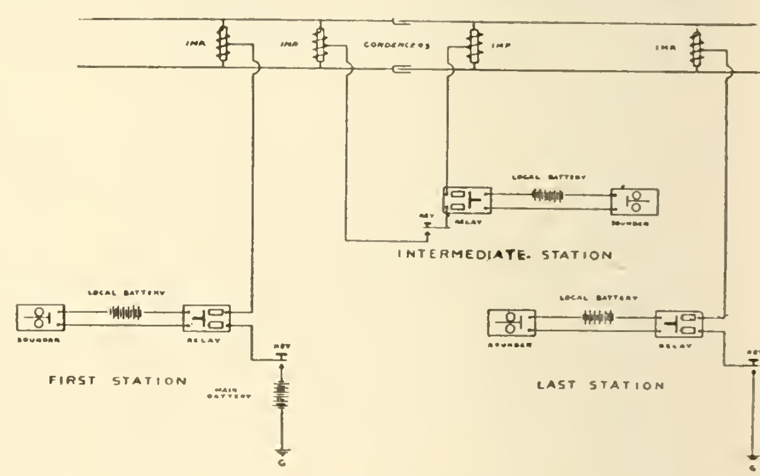


Fig. 2. Telegraph Instruments in Series

talk through these condensers; and while they do not interfere with the small undulating voice currents, used in talking, they do seriously interfere with the signalling current, especially where there is a large number of telephone instruments bridged on to the line. Condensers are very delicate and are an expensive fixture on a long dispatching telephone line, especially where it parallels and is in close proximity to high tension and power lines. They are so sensitive and delicate that they are continually being knocked out, not only by lightning, but by induced static and stray currents from other lines.

In the composite series system these condensers have to be kept in proper order at each station where a telegraph instrument is cut in to the telephone line, or the line will be unbalanced and the telegraph current will interfere with the telephone service. To avoid the use of these expensive and troublesome condnsers and to secure other very desirable results, that will appear later, we decided to connect the telegraph instruments in multiple, more after the continental or European telegraph practice than the American, the telegraph relay being cut in as illustrated in Fig.

1 between the neutral point of a suitably wound impedance coil, bridged across the telephone line, and ground, through about 1,000 ohms resistance.

The telegraph key, which is an open circuit key (key without a lever switch) is cut in from some source of energy in multiple with the relay. As we have the 500 volt d.c. railway circuit at each telegraph station we connect the key in between the fourth and fifth lamps in a series of five 16 c. p. lamps, as illustrated in Fig. 1, so as to obtain about 100 volts on the telegraph line. For the fifth or ground lamp we used four 16 c. p. lamps in series multiple, as illustrated in Fig. 1, which have the same resistance as one lamp, but being in multiple there is no danger of the ground side of the series opening and thus throwing full potential on to the telegraph line.

The sounder is connected in the usual manner, either with local battery, which in this case can be ordinary dry cells, since sounder is on open circuit when not in use; or by shunting the ground light in a series of five incandescent lights in the same manner as power is obtained on the line.

All telegraph instruments on the line, when connected in multiple are of course connected up exactly alike, and require but one impedance coil to each telegraph station and no condensers. They are all independent of each other and any one of them can be cut on or off the line at any time by opening the double pole knife switch.

Another advantage of the multiple system is that it is impossible for the operator to go away and leave the line open by leaving his key open. If the series system were used it would require two impedance coils at each intermediate telegraph station and two condensers as illustrated in Fig. 2.

Another very important feature of the multiple system is that the neutral point of every impedance coil is connected to ground through the relay and about 1,000 ohms of non-inductive resistance. This, on lines paralleling high tension lines, serves to carry off the static current, which otherwise would accumulate on the telephone line.

It is a well-known fact that both sides of the telephone line sometimes acts as a secondary to the high tension line and that a high and dangerous accumulation of static is induced on the telephone line. These impedance coils are so wound and connected that they act as impedance to the undulating voice and a. c. telephone signalling current flowing from one side of the telephone line to the other; but do not act as impedance to current flowing from both sides of the telephone line to the ground. Therefore the static or other stray current of small volume but high potential, can pass unimpeded from both sides of the telephone line to the ground.

On account of the sensitiveness of the telephone receivers to even a slight flow of current, they are very seriously affected by small induced currents from other lines which parallel the telephone line, especially from lighting, power and high tension lines. It is important, therefore, to have a well-constructed telephone line. It must be perfectly balanced as regards resistance, impedance, inductance and capacity; that is, it must have the same resistance, impedance, inductance and capacity in each side of the circuit. Not only must each side total the same, but each side must have the same amount between each talking station. The line must be so transposed that each leg of the circuit shall occupy and travel in the same zone or position relative to other parallel lines and conductors half of the distance between each talking station.

The line must be properly insulated, not only from all other lines, but from the ground and all other objects having capacity and which would unbalance the circuit by adding capacity to one side or the other.

The greatest source of trouble and the one most difficult to overcome on telephone dispatching lines arises from two opposite and opposing conditions. Both of these seem to be necessary, one for the operation of the line, and the other to protect the line and also those who have occasion to use it, from a dangerous difference of potential, between both sides of telephone line and ground, which is liable to be induced from the high tension lines. A difference of potential of 300 to 400 volts will discharge across the protectors usually used on the line, leaving the line safe but not very serviceable, as the capacity of the grounded side is increased so as to unbalance the circuit and cause a continuous flow of current through the receivers on the line from one side of the circuit to the other, making the line so noisy that it is practically inoperative. These protectors or ground devices are usually carbon plates separated about one one-hundredth of an inch by perforated mica or celluloid, one of them being connected to one side of the telephone circuit and the other to the ground. When a discharge takes place from one carbon plate to the other it usually blisters the plate and leaves the line permanently grounded, making it necessary to go over the line and clean the protectors. Dust and dirt are also liable to collect in these protectors and ground the line with the same result.

Thus you are between the "devil and the deep blue sea" all the time. You must not let your line touch the ground and yet you must keep it within one one-hundredth of an inch of the ground in many places.

It is from these two opposite and opposing conditions that nearly all the trouble on telephone lines paralleling a high tension line arises.

Since the installation of the telegraph instruments on the Beaver Valley dispatching line most of the above trouble has disappeared on account of the neutral point of the impedance coils being grounded and carrying off the static and other stray current which otherwise would accumulate and discharge across the protectors and blister them.

The success of any composite system depends of course upon both sides of the telephone line having the same resistance, impedance, capacity and inductance, the same as any ordinary telephone line. In other words, the line must be perfectly balanced, and when it is perfectly balanced the telegraph direct current impulses have no tendency to pass from one side of the telephone circuit to the other through the telephone receivers, and therefore there is no disturbance between the telegraph and telephone service; and since it is necessary to have a well-balanced line to prevent disturbances to the telephone from high tension and other parallel lines, the use of the telegraph on the same line as the telephone does not necessitate any further care than would be necessary for any satisfactory operating telephone line.

A composite system not only doubles the amount of business that can be handled over a single line, but is much more reliable and convenient than either a telephone or telegraph line alone. It is much more reliable because the telegraph and telephone services are not both subject to the same troubles. What would knock out or disable one might not affect the other. Although the telephone is more sensitive both to atmospheric disturbances and to induced currents from other lines, and consequently is less reliable than the telegraph, yet it is more convenient than the telegraph in handling a certain class of business, such as reporting cars at passing points and places where there is no operator, and for reporting breakdowns and interruptions to service, and all kinds of business where it is necessary to get in close touch with the party addressed, and where quick action and an immediate response are required, and where you do not wish to talk through a second party—the operator—but wish to personally communicate with the party addressed. There is sometimes a great deal of satisfaction to talk direct to the train crews, substation attendants, and other employes, and for this class of work the telephone is most desirable. For other classes of work where you do not care for a personal interview a telegraph line has its advantages.

The great trouble with the telephone for dispatching purposes is that it is so delicate and sensitive. The reason for this is that no one has yet been able to design a transmitter that will handle but a very small amount of current. Transmitters are designed to operate on 2 to 4 volts, and as their resistance is from 10 to 20 ohms they consequently will not transmit over about 1 watt, which is an infinitely small amount of current, consequently the receivers have to be made so very sensitive and delicate in order to pick up this small amount of current that they pick up foreign and induced currents from adjacent and parallel lines and consequently are very noisy, unless the line is so built as not to be affected by foreign currents.

If a transmitter could be designed to handle, say 100 watts, then the receivers could be made less sensitive so that they would not be affected by small quantities of induced current from foreign lines, and would not be affected by atmospheric conditions. The composite system has all the advantages of both systems with very little additional expense, and introduces no new troubles or complications, and the liability of the composite system to become inoperative to both telephone and telegraph services is very greatly diminished, since, as stated before, they are not subject to the same troubles.—Electric Traction Weekly.

EXTENSION OF THE SOUTHWESTERN TRACTION COMPANY.

The Southwestern Traction Company, of London, Ont., which has had a line in operation between London and St. Thomas, 18 1-2 miles, for the past twelve months, is now completing its extension from London to Port Stanley, 29 1-2 miles, which is expected to be opened for traffic in July. An official report from C. P. Raikes, chief engineer, states that grading is now completed and the overhead work, which is partly of the bracket type and partly double-pole span construction, is finished as far as Union, 26 1-2 miles. Sixty-pound rails are used throughout. The steepest grade is 4 1-2 per cent. A power house of 1,000 horse-power capacity is located at London, and contains 10,000 volt 3 phase generators, operated by vertical compound inclosed engines, operating at 375 revolutions per minute. Three sub-stations are now under construction. The equipment for the sub-stations and the cars is furnished by the Canadian Westinghouse Company, and the overhead and track equipment by the Canadian Electric Traction Company.

The original line to St. Thomas has three steel bridges with spans of 60, 120 and 180 feet. Six double-truck cars with a seating capacity of 44 are now operated on a 55-minute schedule, with a 5-minute lay-over at each end. Six new cars with a capacity of 54 passengers are now being delivered for the new line to Port Stanley, on which a similar schedule will be maintained during the summer months. During the remainder of the year this section will be operated on a 2-hour headway.

Surveys are now being made for another extension from Lambeth to Delaware, six miles, and construction is to begin in August.

F. G. Rumball is president and S. W. Mower general manager of the Southwestern Traction Company, with offices in the Bank of Toronto Chambers, London, Ont.

REPAIRING A MOTOR.

In the operation of electrical apparatus conditions frequently arise when the engineer is at a loss to know what course to pursue. Sometimes by a little ingenuity and skill obstacles are overcome which at first sight appear insurmountable. Mr. J. Stanley Richmond tells how he recently repaired a 220 volt d. c. motor of 1 1-4 h. p. which had become imbedded in water half way up the field coils. When the current was turned on contrary to orders, one coil became very hot, while the other remained cold. In stripping the covering off the coils it was found that the hot field had nearly all the wire insulation charred and that half of the cold field coil was much damaged by electrolytic action. The following method was adopted to overcome the trouble. Several quarts of wood alcohol mixed with a little shellac varnish was emptied into a dish and the damaged coils soaked for 24 hours, then baked, connected up in series, and sufficient current passed through to thoroughly dry them out. The test before this treatment showed damaged coils, and after the treatment the repair of the damage. The coils were then recovered, erected on the motor, and operated with entire satisfaction. It may be stated that in wrapping the coils ordinary drygoods tape should be used first, with shellac and regular insulating tape as a final covering, painted over with ordinary insulating paint.

ILLUMINATING ENGINEERING SOCIETY CONVENTION.

The first annual convention of the Illuminating Engineering Society will be held in Boston on invitation of Mayor Fitzgerald, during "Old Home Week," the days of the meeting being Tuesday and Wednesday, July 30 and 31. A strong programme of papers will be presented, and there will be an exhibition of illuminating appliances and measuring instruments.

THREE-PHASE VERSUS SINGLE-PHASE TRANSFORMERS.

A careful examination of the relative advantages obtained by using one three phase or three single phase transformers, would indicate that at present the location and the transportation facilities are among the most important points to be considered. Owing to the phase relation in a three phase circuit, the copper and core of a three phase transformer can be made lighter in weight than the cores and copper of three single phase transformers of equivalent capacity. Further, only one casing, which is also of lighter weight than the casings of the single phase transformers, is required. A three phase transformer for a given service does, however, weigh more than each of the one phase transformers for the same service, and for this reason it may sometimes be advantageous to use three single phase transformers in stations not properly equipped to handle heavy pieces of machinery, or where it is necessary to haul them by wagon. The question of weight also enters into the repair problem. The lighter weight single phase transformers are cheaper to repair because of the greater facility with which they can be handled. When transformers must be mounted on poles, the advantages are in favor of the three phase transformers because of the reduced weight and also because of their appearance.

The three phase transformer has the advantage of higher efficiency and simplicity of connections and station wiring. All the connections can be made inside of the transformer case, it being necessary only to bring out the three high and the three low tension leads. Consequently, besides the reduced first cost of the three phase transformer, there is also a considerable saving on the cost of cable for making the connections, accompanied by a lower labor cost.

There is a slight disadvantage accompanying the use of three phase transformers in instances where it is necessary to bring out a large number of taps for different voltages. This complicates the wiring within the case, but such instances are comparatively rare and unimportant. As the radiating surface of a three phase transformer is less than that of three single phase transformers of equal normal capacity, self-cooled three phase transformers cannot be designed (for any allowable temperature rise) for so great a normal capacity in one unit as can three single phase transformers, but the gain in efficiency and in the reduced danger of breakdown when oil or water cooling is employed should settle this question.

One disadvantage of the three phase transformer is that in case of failure of one of the coils, it is highly probable that the remaining coils would be injured, and that it is therefore necessary to keep available a complete unit for emergency purposes. In the case of the single phase transformers only a third of the total capacity need be kept in reserve. As the art of designing and manufacturing transformers progresses, however, the force of this argument diminishes, for breakdowns are becoming less frequent.

As the cost of a three phase transformer is approximately but 80 per cent. of the cost of three single phase transformers of equivalent output, the investment in emergency units will only be greater for the three phase transformer when but one transformer is installed, and will probably be less than the investment required for the three single phase transformers if the installation consists of a number of units.

In cities where real estate is valuable the great saving in floor area, and in a slightly reduced height, furnishes a strong argument in favor of the three phase units. This point deserves especial consideration when transformers are installed in sub-cellar substations, where in many cases only a certain amount of space is available, and additional room, without consideration of the cost, is practically unavailable. The regulation of the three phase and three one phase transformers is equally good with changes of load or power factor and need not, therefore, be considered.—Electric Railway Review.

LONG DISTANCE DIRECT-CURRENT TRANSMISSION.

According to a writer in "Cassier's Magazine," there are eighteen plants in successful operation in Europe employing the continuous current varying voltage system devised by M. Rene Thury. These plants aggregate 18,000 horse-power, the current varying from 40 to 250 amperes and the voltages from 1,600 to 60,000, the latter tension being used in the Moutiers-Lyons transmission, which is over a distance of 112 miles.

The special advantages claimed for the continuous current over the alternating system are as follows:

First—The economy in transmission line material and switchboards. Recent data show that on a line 95 miles long the saving in transmission copper, poles, insulators, lightning arresters, etc., was estimated to exceed 50 per cent., where the direct current voltage was 150,000 (grounded neutral) and the alternating current, three phase voltage 60,000, the line efficiency being 95 per cent. approximately for the continuous current and 91 per cent. for the alternating current, calculated values on the same comparative basis.

Second—The switching arrangements consist of one revolving switch placed on a post mounting the apparatus, and one of these is required for each group of generators, and in addition for the whole station only one other main station switch. This is claimed to lead to extreme simplicity in operation and some economy and saving in the number of operators.

Third—Freedom from lightning trouble is claimed, and it is pointed out that this is obtained by the use of a large inductance at each end of the line, the usual horn arresters and resistance with spark gaps for atmospheric discharge, while inside of all this a large condenser is placed, having the effect of absorbing any high peak of voltage which may pass the other somewhat standard devices.

Fourth—Freedom from mutual induction troubles is also obtained, static or capacity discharge considerably reduced, the distance apart of the wires becoming solely a question of brush discharge.

With the continuous current it is possible to reduce the potential to earth 50 per cent. by grounding the middle point of the generating system, the units of which are connected in series; this makes it possible to operate at voltages up to 200,000.

It is now proposed to transmit 80,000 horse-power from the Rhone river to Paris—a distance of 250 miles—using a voltage of 120,000.

SPARKS.

Black Bros. propose to install an electric light plant at Cobalt, Ont.

The construction of a street railway at Moncton, N.B., is being agitated.

The Electric Smelters, Limited, of Ottawa, was incorporated recently to engage in the electric smelting of ore.

The Bell Telephone Company are constructing a new switchboard in their exchange at Galt, Ont., of the central energy type.

The British Columbia Telephone Company have purchased property on Clarkson street, New Westminster, B.C., on which to erect a new exchange.

A United States patent has been granted to Dr. C. A. Tunstall, of Kamloops, B.C., for an ingeneous pole-changing device for electric currents.

The Council of Strathcona, Alta., are still negotiating with the Strathcona Radial Tramway Company concerning a franchise for an electric railway at that place.

The ratepayers of Sherbrooke, Que., recently carried by a large majority a by-law to raise $200,000 to develop the "Basin" power at Westbury for the generation of electricity.

The Civic Commission of Ottawa is making arrangements for taking over the street lighting system of the Ottawa Electric Company, in accordance with the terms of the contract. The Commission will offer $24,000 for the equipment now utilized in the service.

The ratepayers of Goderich, Ont., will be asked to vote on a by-law to enable the carrying out of the proposed scheme to develop a water power on the Maitland river. Mr. J. W. Moyes, of Toronto, has interested himself in the project.

The electric plant of Berlin, Ont., is taxed to its capacity. Accordingly the Light Commission recently gave a contract to the Central Heating Company for a supply of 400 horse-power for three years and 500 horse-power for two years, this additional power to be ready by October next.

The report of Messrs. Holgate, MacDougall and Ker upon the water powers at Britannia, Deschenes, Hull, The Livere, The Chats and Chelsea will likely be submitted to the City Council this week. The report is for the purpose of determining upon the most suitable power to be developed as a source of supply for the municipal electric plant.

The Farmers' Telephone Company has commenced business at Delta., B.C., with 25 miles of poles and 90 subscribers. The officials of the company are: William McKenzie, of Woodwards, president; H. M. Vasey, vice-president; Dr. Traynor, Steveston, secretary. The system has been established on a co-operative basis, each subscriber taking 30 shares at one dollar each and paying 75 cents a month for the service. The company will have its central office located at Ladner.

It is probable that the British Columbia Electric Railway Company of Vancouver will have to temporarily re-start their steam power plant in order to keep pace with the additional demands for power. At the present time they are increasing their power house capacity by the installation of additional waterwheels and other machinery, but owing to strikes, etc., at the factory there is some doubt of their receiving the waterwheels in sufficient time. In event of the company starting up their steam plant, it will be necessary to make some rearrangements to suit present conditions. The plant was originally two phase 10,000 volts, and it will be necessary to step it up to three phase 20,000 volts so as to cut in on the tension lines. The tunnel and other work at the power house is being pushed ahead as rapidly as possible.

SPARKS.

Surveys are being made with a view to developing a water power on the Madawaska river near Arnprior, Ont.

The Hamilton Cataract Power, Light & Traction Company have filed plans for a transmission line through Barton and Saltfleet townships.

The Municipal Council of Morden, Man., have passed a by-law to borrow $20,000 for the purpose of constructing or purchasing an electric light plant.

Work will commence immediately on the electric railway line between New Westminster and Eburne, B.C., which is to be built by the British Columbia Electric Railway Company.

The corporation of North Battleford, Sask., is asking for tenders up to July 31st for the construction of waterworks and sewerage systems. Tenders for buildings, machinery and electrical equipment will be invited next month.

The Alberta Government have 75 men engaged in erecting telephone lines. At present five lines are under construction, namely, Edmonton to Lloydminster, Wetaskiwin to Daysland, Lacombe to Stettler, Blairmore to Calgary, and Calgary to Banff.

Alderman Manning has moved in the City Council of Winnipeg that the Railway Commission be requested to issue an order compelling the Bell Telephone Company to place all their wires underground in the district in which the city proposes to construct conduits.

It is proposed to submit a by-law to the ratepayers of Moose Jaw, Sask., to raise $90,000 to extend the power plant. A boiler house will be built and two new boilers installed immediately. Next year it is proposed to add two more boilers, a 500 kw. steam turbine unit, a feed water heater, a boiler feed pump and condenser, with the necessary foundations and piping.

The annual meeting of the St. Martins Telephone Company was held at St. John, N.B., last month, at which the extension of the company's lines to Ten Mile Creek was decided upon. The question of replacing the present telephones by those of a more modern type was also considered. Mr. C. M. Bostwick was elected president, W. E. Skillen vice-president, and A. D. McMackin secretary-treasurer.

The promoters of the Stave Lake Power Company originally planned to harness the power of the Stave river in order to supply electrical energy to the city of Vancouver and surrounding districts, but plans are now being perfected whereby this power will be used for the operation of existing steam roads. Early in 1909 the first steps towards the electrification of the Great Northern Railway are expected to be taken. In all probability the conversion of the Vancouver, Victoria & Esquimalt Railway between Cloverdale and Sumas will be finished in the same year, and ultimately it is proposed to handle the trains by electricity all through the Fraser Valley.

SPARKS.

The Maple Leaf Electrical Manufacturing Company have commenced operations at Galt, Ont.

It is understood that the amount necessary for the construction of the Chatham, Wallaceburg & Lake Erie Railway to the lake has been subscribed, and that the work will be begun at an early date.

An adjourned meeting of the stockholders of the New Brunswick and Central Telephone Companies was held at Fredericton on June 24th for the purpose of electing directors, fifteen in number. The following board of directors was unanimously elected for the ensuing year: Senator Thompson, W. T. Whitehead, Williard Kitchen, Fredericton; F. B. Carvell, M.P., Woodstock; C. W. Fawcett, H. C. Read, A. W. Bennett, F. Black, Sackville; R. O'Leary, Richibucto; G. W. Ganong, M.P., St. Stephen; G. W. Fowler, M.P., H. P. Robinson, Sussex; S. H. White and J. D. Irving, Buctouche. S. H. White was elected president; Senator Thompson, first vice-president; F. B. Black, second vice-president; and Alfred Seeley, secretary-treasurer.

SPARKS.

The electric light plant at Newmarket, Ont., is being extended.

The Bell Telephone Company are installiug a new switchboard at Calgary.

The City Council of Chatham, Ont., are considering the question of enlarging the electric light plant.

The New Cumberland Telephone Company are installing a new switchboard in their exchange at Amherst, N.S.

The Coquitlam-Burnaby Telephone Company is seeking operating rights from the city of New Westminster, B.C.

A new exchange is being built at Peterboro' by the Bell Telephone Company, the contracts for which were awarded last month.

The Galetta Electric Power & Milling Company, Limited, has been incorporated, with a capital of $100,000 and head office at Arnprior, Ont.

Mr. Frank Schneider has purchased the electric light plant of Wilton Bros. at Morden, Man., and will remove it to one of the small towns in British Columbia.

The ratepayers of Port Arthur, Ont., will vote on by-laws to provide $60,000 to construct dams on the Current river and $15,000 for the purchase of new street cars.

An Ontario charter has been granted to the Brougham & Grattan Telephone Company, Limited, of Dacre, Ont. The provisional directors include Messrs. Joseph Legree and Philip Bradley, of the Township of Brougham.

The Hamilton Cataract Power, Light & Traction Company will build another transmission line from Hamilton to DeCew Falls. The company have already two lines and will build a third as an auxiliary to insure a steady service.

The Hydro-Electrical Construction Company, Limited, have beeu incorporated, with a capital of $50,000. The head office will be in Toronto. The provisional directors include Messrs. Alexander Keith, A. G. F. Lawrence, and W. R. Wadsworth.

Messrs. Stoue & Webster, the Boston capitalists, have purchased the line and franchise of the Everett Electric Company, Everett, Wash, including an interurban line extending to Snohonish City, about ten miles in length. It is believed that this company will eventually build an electric railway from Seattle to Vancouver.

The Spokane Falls Placer Mining Company are arranging to install a power plant to supply the city of Trout Lake, B.C., and also the nearby mines with light and power. The company is capitalized at $250,000, Minnesota capitalists holding a controlling interest. Messrs. J. B. Campbell, H. Moss, R. E. Sheppard and V. K. Waguer, of Spokane, are also interested.

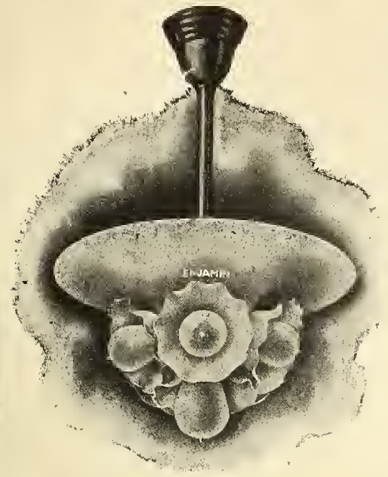
The Hydro-Electric Commission of Ontario have moved into new offices iu the Continental Life Building, corner of Richmond and Bay streets, Toronto. The Commission are now making surveys for the several transmission lines, the intention being to have all the data necessary in case the Government decides to erect its own transmission liues and the municipalities perform their part.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

SEVENTEENTH YEAR. No. 8. TORONTO, MONTREAL — AUGUST, 1907 — WINNIPEG, VANCOUVER PRICE 10 CENTS $1.00 PER YEAR.



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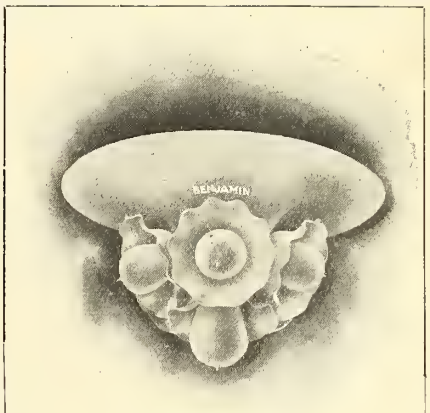

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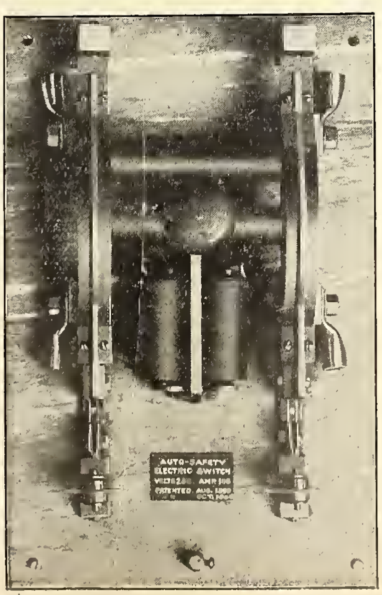


MOONLIGHT SCHEDULE FOR SEPTEMBER

Date.	Light.	Date.	Extinguish.	No. of Hours.
Sept. 1	7 00	Sept. 2	2 00	7 00
2	7 00	3	2 45	7 45
3	7 00	4	3 40	8 40
4	7 00	5	4 30	9 30
5	6 50	6	4 50	10 00
6	6 50	7	4 50	10 00
7	6 50	8	4 50	10 00
8	6 50	9	4 50	10 00
9	6 50	10	4 50	10 00
10	6 50	11	4 50	10 00
11	6 40	12	4 50	10 10
12	6 40	13	4 50	10 10
13	6 40	14	4 50	10 10
14	6 40	15	4 50	10 10
15	10 00	16	5 00	7 00
16	11 00	17	5 00	6 00
18	0 00	18	5 00	5 00
19	1 15	19	5 00	3 45
20	2 30	20	5 00	2 30
21	No Light	21	No Light	
22	"	22	"	
23	6 20	23	8 50	2 30
24	6 20	24	9 20	3 00
25	6 20	25	9 50	3 30
26	6 20	26	10 30	4 10
27	6 20	27	11 10	4 50
28	6 20	28	11 50	5 30
29	6 10	30	0 40	6 30
30	6 10	Oct. 1	1 30	7 20
		Total	....	195 10

The Ontario Railway and Municipal Board will make an extended tour of inspection, covering all the electric and steam railways under its jurisdiction. Rolling stock, appliances, equipment, fares, etc., will be carefully examined to see that the requirements of the law are being observed. The ground covered will extend from Cornwall to Sarnia.

CLASSIFIED IDNEX OF ADVERTISERS.

SPARKS.

The capital stock of the Pueblo Tramway, Light, Heat & Power Company has been increased to $6,500,000.

Mr. Alex. Dow, consulting engineer, of Detroit, and Mr. C. B. Smith, C.E., of Toronto, have been engaged to act with the City Engineer in preparing a report on the cost of a distribution system for Toronto.

An Ontario charter has been granted to the King Telephone Company, Limited, with head office at Temperanceville, and a capital of $10,000. It is proposed to construct a telephone system in the County of York.

The construction of the new Engineering Building at McGill University, Montreal, the plans for which were prepared by Prof. Nobbs, is now well under way. The building will be fireproof and will cost in the vicinity of $275,000.

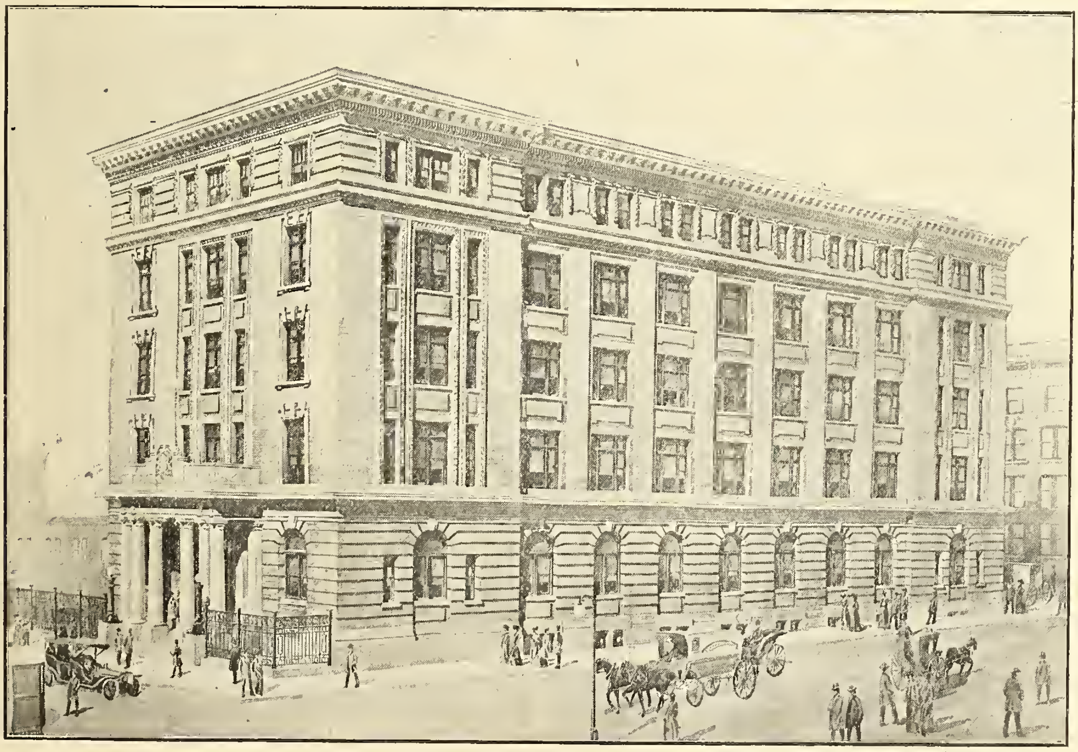
Streetsville, Ont., has adopted the public ownership principle and is now developing a water power for the purpose of supplying electric power. A by-law to raise $15,000 for the purpose was carried by the ratepayers a short time ago.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XVII. AUGUST, 1907 No. 8.

NEW OFFICE BUILDING FOR THE CANADIAN GENERAL ELECTRIC COMPANY.

The accompanying illustration represents the new building of the Canadian General Electric Company, now being erected on the northwest corner of King and Simcoe streets, Toronto. The structure, which is of the modern office style of architecture, has a sixty foot frontage on King street, and runs back the whole depth of the block to Pearl street, a distance of one hundred and eighty-six feet six inches. The height of the building is eighty feet, giving five lofty storeys. It will be of absolutely fireproof construction, of skeleton steel, and dark grey brick, with stone and terra cotta trimmings. In the centre of the King street frontage is an imposing entrance of cut stone of classic design. To the west of the building a lot forty feet wide, running the whole depth, has been reserved, so as to give plenty of light on all four sides. A tall wrought iron fence runs the whole length of the King street frontage, with a massive stone gateway leading into the land to the west.



NEW OFFICE OF THE CANADIAN GENERAL ELECTRIC COMPANY, KING STREET WEST, TORONTO.

The entire building will be occupied by the Canadian General Electric Company and Canada Foundry Company. The ground floor will be taken up by the head offices, and the other departments will occupy the upper storeys. Messrs. Darling & Pearson are the architects. The structure, when complete, will be one of the finest office buildings in Toronto.

A BURNT OUT LAMP OR A BROKEN FILAMENT.

Incandescent lamps are frequently turned in by employees as being burnt out when as a matter of fact the lamp filaments have been broken by careless handling of the globes. This is a matter that is worth watching and a little "lecture" on care in handling the lamps may result in cutting down the cost of renewing lamps. An infallible test for telling whether or not the filament has been broken is as follows: If the filament has been broken by dropping the lamp, or any severe jar, the ends of the filament will be square at the point of breakage. If the lamp failed from burning out the ends of the filament will invariably be pointed. The best way to see the break is to hold the lamp in front of a sheet of white paper.

The Colonial Engineering Company, of Montreal, have secured the contract for additional apparatus for the electric light plant of Chatham, Ont.

NIAGARA POWER AT THE LACKAWANNA STEEL PLANT

By John C. Parker
Mechanical and Electrical Engineer.

A few years ago the West Seneca works of the Lackawanna Steel Company were established. At these works electrical energy is used for many of the incidental processes. Owing to the large size of the gas engines, and the extent of the installation, considerable attention was attracted to the equipment for utilizing blast furnace gases for the generation of power. This gas engine plant was installed for the purpose of operating motors at various points in the plant, these being used for large cranes, gantries, unloaders, conveyors, etc., for the operation of a trolley system, and for the operation of roll tables in the mills. The load is of a decidedly fluctuating character on account of the frequent starts and stops, and the concentrated character of the loading. The load factor, however, is very good as compared with that of a railway or lighting plant.

The utilization of the blast furnace gases necessitated the concentration of the power generating equipment in one point, so that, with the extension of the plant, considerable losses have become inevitable in transmitting the power at the present low voltages of 250 volts direct current and 440 volts alternating current. To adopt a distributed generating system would involve the abandonment of the gas engine as a prime mover. On the other hand, if the concentrated system were to be retained, extensive and more or less unsatisfactory step-up apparatus would be necessary to cut down the losses in the alternating current network, entailing a remodeling of the cable system to accommodate the higher voltage. Nothing whatever could be done to remedy the extensive loss in the direct current distribution, unless inverted rotary converters were made use of at the power house and corresponding converters at the point of utilization, an arrangement which possesses manifest disadvantages and would be tremendously costly.

As the steel works have grown, the demand for power has exceeded the present supply of blast furnace gas, so that extension of the local generator plant would have involved the use of coal, which would have been out of the question as a competitor to Niagara Falls power. Some advantage obtains from the fact that the capacity of the Ontario Power Company's generating plant is very large in comparison with the normal demands of any individual customer. This gives assurance against interruption due to disabled generating apparatus and permits the occasional carrying of a great excess over the ordinary loads. An appreciation of these facts has led the Lackawanna Steel Company to contract with the Niagara, Lockport & Ontario Power Company for electrical power, transmitted from the plant of the Ontario Power Company at Niagara Falls, Ontario.

The brief description here given of the installation for transforming and distributing this power in the works of the Lackawanna Steel Company, together with a discussion of the more salient features, it is hoped, may prove of some interest. In any event, the rapid progress of the electrical art makes desirable a frequent comparison of notes regarding methods of design and operation.

The engineers of this work had primarily in mind three features, very usual ones in any engineering installation, namely, reliability and continuity of service; facility of operation, and maximum total economy. The paramount importance of reliability in such an enterprise as that of the Lackawanna Steel Company is so obvious as to require no comment. It was felt that reliability could be best attained by the utilization of as absolutely simple and "fool proof" apparatus as could be obtained, and by making all parts of the construction straightforward, simple, and readily accessible at all times. This condition in the design accomplished the other two ends which were desired.

The new electrical equipment, in general, consists of four stations; the sub-station containing transformers which step the energy from 60,000 volts to 2,200 volts; and three feeder stations, which receive the energy at 2,200 volts at as many different points in the plant and there convert it to 440 volts alternating current and 250 volts direct current. It is with the equipment of these stations and the intermediate 2,200 volt feeders that the present article is concerned. The 60,000 volt transmission line supplying the plant is a part of the system of the Niagara, Lockport & Ontario Power Company, designed under the engineering direction of Mr. R. D. Mershon.

60,000 Volt Sub-Station.

Incoming Lines.—Power enters the sub-station at 60,000 volts through disconnecting switches which may be operated from a balcony on the front of the station building; thence passing inward through oil circuit breakers and series transformers, it is delivered to the station bus bars, which form a loop immediately under the ceiling. These bus bars are of one-fourth inch copper tubing, supported by standard 60,000 volt line insulators. In the oil switch room a cross connection is provided, so that power may be delivered to either side of the loop from either incoming line. The high voltage bus bars are sectionalized by inverted knife switches hung from to either side of the loop from either incoming line. The high voltage bus bars are sectionalized by inverted knife switches hung from the roof, so that each bank of three transformers may be isolated for changes in the bus bar system, or for cleaning insulators, if desired.

The Transformers.—From 60,000 volt bus bars current passes through fused circuit breakers—which act as an auxiliary and selective protection to the various transformer banks, and thence in at the top of the transformers. The transformers are arranged in two rows of six each, and are of 1,000 kw. capacity at normal loads and are of the oil-insulated, water-cooled type. Of the ultimate twelve transformers, six only have been installed at present, making two banks with a seventh or spare transformer with means for connecting it into the place of any of the six. The secondaries are wound for 2,500 volts with intermedi-

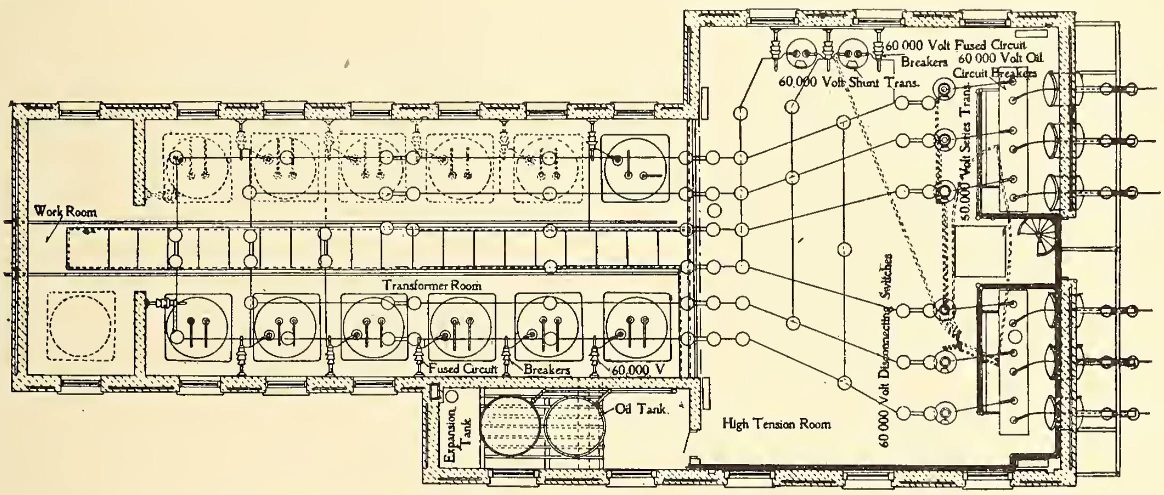
ate taps down to 2,200 volts, and are delta-connected, the primaries being star-connected, and having the neutral formed by internally grounding one end of each winding to the transformer case, which is in metallic contact with a pair of rails embedded in the building foundations, as well as with the water and oil pipe systems. The transformers rest on I-beams bolted to these rails, and can, by the insertion of steel rollers, be skidded off the I-beams to a small transfer car, which runs on tracks in the middle of the transformer room. Two spare transformer stands are provided in a room at the rear end of the station, in which transformer cases may be assembled, oil dried and tests run. This room is served by a fifteen ton chainblock hoist supported by a twenty-four inch transverse I-beam immediately under the roof. This arrangement obviates the need for a crane in the building with its attendant objectionable features. The transfer truck may be run out on rails at the rear end of the building and the transformer lifted by means of a railroad yard crane on to the tracks of the plant, so that any part of the transformer may be carried to the machine shop, or elsewhere for repairs.

Transformer Compartments.—Careful investigation has proved that it would be practicable to install the transformers without isolating barriers; in fact, that such provisions are not only unnecessary but are positively objectionable because they involve complications in construction and prevent the greatest accessibility. Accordingly the transformers have been placed with no barriers, and with only sufficient space between them to allow proper electrical clearances and safe accessibility for inspection.

Transformer Oil Systems.—A similar investigation has led to the abandonment of the more complicated fire quenching and oil emptying systems which have been quite commonly employed of late. The recorded facts in regard to transformer difficulties seem to bear out the theory that these transformers are about as good a fire risk as can be had when placed in a building of fire resisting construction and containing no large quantity of combustibles. The small quantity of air in the transformer cases and the difficulty of igniting insulating oil renders impossible the development of any high pressures, and improbable the ignition of oil vapors. Of course a protracted short circuit occurring simultaneously with non-operation of the fused circuit breakers and of the oil circuit breakers, would result in the building up of internal pressure, due to the boiling of the oil, a condition which is very remotely extreme. To guard against any possible difficulty from such excessive internal pressure, the transformer cases have been vented at the top to two and one-half inch pipes leading both to the roof and to the sewer system, and each vent is provided with a check valve for the exclusion of moisture, as well as for the prevention of the communication of difficulties from transformer to transformer. This system gives all desirable safety and prevents the liability to accident due to the excessively complicated systems of piping involved in sewer drains and flushing connections.

In recognition of the desirability of being able to periodically cleanse and dry the oil used in the transformers, and at the same time to empty and re-fill transformer cases rapidly in the event of accident, a system has been adopted which combines gravity emptying and gravity filling with a filtration and drying of the oil in passage from the submerged storage tank for impure oil to the elevated storage tank for impure oil. Entirely separate lines of piping are carried through a central trench in the building for the purpose of carrying oil to and away from the transformers, so as to prevent the trapping of impure oil which would be washed back by the clean oil in refilling if a single line was used. The filling and emptying pipes are two and one-half inches in diameter, and of short run, so that the gravity head can fill a transformer tank in a very short time, much shorter than could be attained with any reasonably small pump, acting directly.

2,500 Volt Wiring and Bus Bars.—Current passes through cambric-insulated cables from the transformer secondaries along the transformer room walls into the switchboard room, and through oil circuit breakers to the station bus bars. The station bus bars are at present a simple straight run of one-eighth by three inch copper straps supported on 5,000 volt line insulators by studs fastened into the wall. It is expected that the excellence of the insulation will obviate the necessity of a parallel bus, but provision is being made at the present time for extending the present bus all the way round the switchboard room to form a ring, divided into sections by knife switches; thus segregating the various feeders and transformer taps. The present four feeders supplying the Steel Company's plant will be taken out through oil circuit breakers to 500,000 c.m. three phase 2,500 volt



Plan View of Transformer and High Tension Rooms of Lackawanna Steel Company's Substation.

cables and thence through an underground conduit system to the various feeder stations.

The Distributing System.

All secondary current at present delivered to the Steel Company's plant from the sub-station will be transmitted to feeder station No. 2, although it is believed that ultimately feeders will be segregated and run to the various centres of activity, their outer ends being connected to form a ring system for the improvement of the load factor on the feeders. Perhaps no part of the installation has been a matter of so careful and anxious thought as this distribution system. The conditions of mechanical operation in the plant are so extremely severe as to render it impossible to do anything in the way of cutting fine the the design of the duct system. After numerous studies had been made the engineers of both companies finally settled upon the standard construction of the Lackawanna Steel Company, which consists of a group of quadruplex tile ducts, carried on pile foundations by reinforced concrete arches of thirty foot span. The arches are necessitated by the extremely light character of the soil found in most parts of the company's grounds, which requires extensive piling for almost all structures placed. Any of the more ordinary types of duct construction was prohibited by the liability to fracture, due to the inevitable and indiscriminate placing of heavy stacks of billets, rails, etc., and the running of the railroad tracks through all parts of the plant.

The cable sections have been calculated to meet three conditions; first, when all are in commission and carrying normal load the cables should develop the minimum annual cost for power distribution; second, when one-half of the cables are out of commission for repair, or change, or on account of accident, the voltage drop must not be too large for the operation of the synchronous apparatus, or for regulation; third, under these conditions of double normal overload on each cable, overheating of the cables shall not result. These of course are the conditions ordinarily obtaining in such work. As the distance of the transmission is short and the secondary voltage reasonably high, meeting the first condition has fulfilled the other two.

The secondary voltage for the plant was determined by a comparison of the economies resulting from the voltage selected and double this voltage. The annual cost of distribution is so low with the conditions chosen that the superior economy resulting from the higher voltage is very small, and although switching apparatus could be a little lighter with higher potentials, operative safety is felt to be sufficiently greater with the voltage chosen to warrant even a considerable sacrifice for the sake of insuring continuity in operation and safety to the operatives.

The Feeder Stations.

A detailed description of the feeder stations is scarcely warranted, as they involve nothing unusual. No. 1 feeder station consists of an installation of one bank of 2,200 to 440 volt 375 k.v.a. oil-insulated, self-cooled transformers connected in double delta, together with two 1,000 kw. and one 500 kw. synchronous motor generator sets for conversion from 2,200 volts alternating current to 250 volts direct current. These machines are all installed in the power house of the Lackawanna Steel Company, and feed into the present extensive switchboard. This station is fed from feeder station No. 2 by means of three phase cables, No. 4-0 per conductor.

Feeder station No. 2 receives all the energy delivered from the sub-station and distributes it by means of non-automatic oil switches to feeder stations Nos. 1 and 3. It has an equipment consisting of a bank motor generator sets. Provision is made for a second of double delta 2,200 to 440 volt oil-insulated, self-cooled transformers, and two 500 kw. synchronous motor generator sets. Provision is made for a second bank of transformers. The equipment at feeder station No. 3, which is connected to station No. 2 by means of duplicate overhead feeders, is similar to that of No. 2 feeder station, except that there is only one motor generator set, and that the present transformer bank consists of 100 k.v.a. transformers.

Operation.

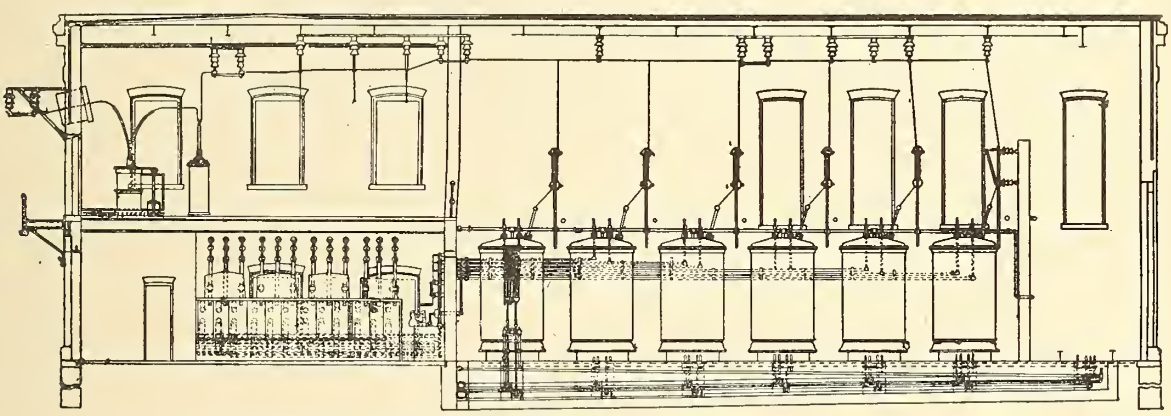
Method of Improving the Power Factor.—The present direct current load at the steel plant is much in excess of the alternating current load, and the plant load factor is very good. The alternating current power factor, however, is not very high, as the equipment consists of relatively small induction motors, many of them running at only fractional loads most of the time and starting frequently. As the purchaser of power wishes to keep it up to as nearly unity power factor as possible, both for economy in his own conductors and in view of the conditions of purchase, some form of synchronous apparatus was desired to compensate for the lagging alternating current load. Three methods were suggested: first, the installation of a synchronous condenser; second, the use of rotary converters; third, the use of synchronous motor generator sets.

Had the first scheme been adopted it would have necessitated the building of a machine with very special characteristics, and the installation of a special switchboard to take care of it, the use of valuable room, and, moreover, the very large and unnecessary expense of building a machine specifically for this purpose, whereas by combining load current with wattless leading current in already loaded motors, the same result can be very economically obtained. Moreover, the correction for lagging current would have been felt only at the point where the synchronous converter was placed, and not on other parts of the distribution system, so that only one of the objects would have been accomplished. On the other hand, this offers the advantage that the sub-station operator has the control of power factor in his hands rather than having it distributed in the various feeder stations.

Either rotary converters or synchronous motor generator sets would have attained the end sought for, and it became a question between these two. There is hardly any difference in cost or efficiency between the motor generator sets taking current directly at 2,200 volts and rotary converters with their accompanying transformers. As the 250 volt distributing system of the Lackawanna Steel Company offers a common connection between all the generators in these sets it was desirable to find some means of apportioning the load between various stations, so as to keep as high an

equipment load factor on the converting apparatus as possible. This could be done by varying the field excitation of converters if sufficient line reactance were present or were introduced, but such an end would be attained only at the sacrifice of phase control. Moreover, it was desired that this end should be accomplished more or less automatically by having the voltage characteristics of the generators rise from 250 to 275 volts at full load, and then to sharply drop so that the machine would automatically "lie down" on overloads, an end impossible in a well-designed rotary converter.

Equalizing the Load.—As it is desired that the draft of power from the Ontario Power Company's generating plant shall be free from peaks, the Lackawanna Steel Company will operate part of its present equipment in parallel with the transmission line. For this reason, as well as for the equalization of loads on the various machines, it was desired that the voltage of the converting apparatus should be above the voltage of the original plant of the Lackawanna Steel Company up to a point representing normal load on the former machines, and that the voltage should then drop to a value below that of the old plant, that is, the regulation of the new installation should be purposely made rather poor above a certain value of load. Below this point the Niagara transmission will tend to take all of the load, but no additional load above this point.



Sectional Elevation of Lackawanna Steel Company's Substation.

If rotaries were used giving a continuous drop of voltage from no-load, the voltage characteristic of the new plant could be made to intersect the more nearly flat voltage characteristic of the present equipment, but such an intersection would be "long" and liable to large displacement due to the variations in the voltage of the transmission line, or of the machines which might be run for the purpose of flattening the peaks. Moreover, such an arrangement would not tend to prevent excessive overload of the individual converters in the immediate vicinity of a concentrated load and would give obviously bad voltage characteristics on the system as a whole. These considerations led to the selection of the present synchronous motor equipment.

This article can scarcely be regarded as complete without an acknowledgment of the kindly and generous assistance received from the engineers of the Westinghouse Electric & Manufacturing Company, who supplied the electrical equipment, and of the ample support given by the officials of the Lackawanna Steel Company—especially should be mentioned Mr. W. A. James, chief engineer of the Lackawanna Steel Company, and Mr. G. M. Sturgass, electrical superintendent. The pleasure of association with these gentlemen has added much to the interest of the development. The architectural treatment of the sub-station was in the hands of Messrs. Green & Wicks, of Buffalo, who have given an unusually satisfactory appearance to the building. It has been particularly gratifying to note how very good an appearance has been obtained by keeping the design strictly consistent with the purpose to be attained, that is, by a strong and simple treatment of the structural material with absolute freedom from attempts at ornamentation.

Good form restricts the writer from making as complete an acknowledgment as he would like, of the direction and guidance received from his chief, Mr. F. B. H. Paine, under whom, as chief engineer of the Iroquois Construction Company, this work was carried out.—"The Electric Journal."

TO APPROXIMATE A POWER FACTOR OF UNITY.

In Sheffield, England, where the electric motors connected to the mains of the municipal electrical undertaking number 831, aggregating 7,000 horse-power or 5,250 kilowatts, the supply being alternating, both single and two phase, 50 periods, 200, 400 and 2,000 volts, special efforts are being made to deal with the very low power factors which obtain in the works of large consumers. A machine is about to be installed with the object of relieving the plant and mains of the excessive amount of idle current which sometimes occupies them. It will be situated at the old generating station in the town and will serve to keep the trunk mains from the new station, two miles away, loaded at a power factor approximately equal to unity. This machine will be of 600 kilovolt-amperes capacity, and in order to keep the starting current low it will be started by a small induction motor and switched into parallel on attaining synchronous speed, in the same manner as an ordinary generator. A power factor meter is to be provided, so that the effect which the machine is producing may be read at intervals. The cost of the machine is $4,000, and the running expenses are estimated at $1,000 per annum. On the other hand, plant and mains to the extent of 420 kilowatts will be liberated, and the estimated cost of which, without buildings, is put at $25,000 and the capital charges at $1,500 per annum. It is thus seen what an improvement it is hoped to effect by the installation of the machine.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

The forthcoming convention of the Canadian Electrical Association in Montreal will doubtless bring together a very large number of the electrical fraternity. The convention itself promises to be unusually interesting as a result of a carefully arranged programme of papers and entertainment, while as additional attractions there will be a meeting of the Canadian Street Railway Association and an Electrical Exhibition. The convention of the Electrical Association will be held in the rooms of the Canadian Society of Civil Engineers, 413 Dorchester street west, Wednesday, Thursday and Friday, September 11th, 12th and 13th, while the Electrical Exhibition will be in the Drill Hall on Craig street, opening on September 2nd and continuing for two weeks. Further particulars of these important events will be given in the September number of The Electrical News, but in the meantime, if you are not a member of the Canadian Electrical Association, send in your application to the secretary.

The members have recently received from Mr. A. A. Dion a list of questions for the Question Box, covering a variety of subjects. It is the duty of every member to promptly send in answers to as many questions as he can and to assist the Editor in every possible way. Co-operation in this work means a great deal to him and to the Association.

ALTERNATING CURRENT MACHINE WITH SHUNT MOTOR CHARACTERISTICS.

The American patents have recently been granted to Mr. B. G. Lamme, to Mr. C. Renshaw, and to Mr. Lamme and Mr. Renshaw as co-inventors, dealing with the common subject of an alternating current machine possessing the characteristics of a variable speed

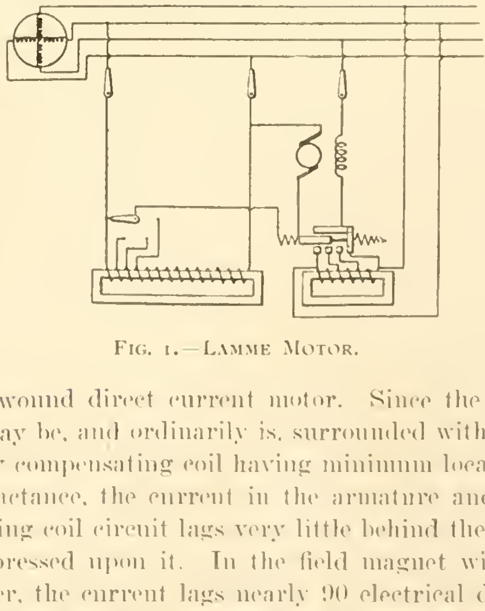


Fig. 1.—Lamme Motor.

shunt wound direct current motor. Since the armature may be, and ordinarily is, surrounded with a stationary compensating coil having minimum local leakage reactance, the current in the armature and compensating coil circuit lags very little behind the E. M. F. impressed upon it. In the field magnet winding, however, the current lags nearly 90 electrical degrees behind the E. M. F. impressed upon that circuit. The E. M. F. generated in the armature is in time phase with the field flux, hence it is in time quadrature to the field circuit E. M. F. It would seem, therefore, that if the E. M. F. applied to the field circuit differs 90 degrees in time phase from that across the armature circuit, the currents in the two circuits will differ very little in phase. The inventors propose to employ a polyphase generator as a source of power for the motor. One of the simplest schemes is shown in Fig. 1, where the auto transformer is used to obtain a variable E. M. F. for the armature, while its central point affords a convenient connecting tap for giving the proper quadrature phase position to the E. M. F.

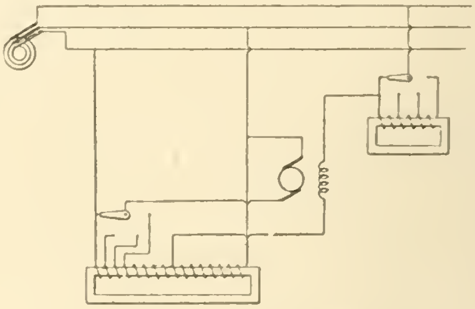


Fig. 2.—Renshaw Lamme Motor.

impressed across the field circuit, the variable impedance in series with the field coils serving to adjust the field current to the desired value. The several patents relate to methods and means for varying the field circuit current both in value and in time phase position automatically with change in the value of the armature current, one of the schemes proposed being indicated in Fig. 2, where the source of supply is a two phase generator.

RAILWAY POWER FOR PUMPING.

A prominent engineer has suggested the feasibility of improving the load factor of electric railway power plants by the sale of current for use in pumping stations. Inasmuch as some interurban companies during the past two years have derived substantial revenues and bettered their load curves by the sale of 500 volt current to farmers for lighting and power purposes, there would seem to be a possibility in this suggestion worthy of some consideration. If, for example, an interurban line has on its route a number of small towns or villages, each with its own pumping plant and standpipe, the conditions are, indeed, favorable for considering the sale of power. It is suggested that instead of the usual steam pump with its irregularly operated and therefore inefficient boiler plant and steam pump, there could be substituted a pressure pump driven by an electric motor connected through a centrifugal clutch, the clutch to be thrown in during the period of light load at the power station. With a number of such installations taking their current from the railway power feeders and each pumping into an elevated tank or a standpipe as ordinarily used in small city water systems, the load factor could be well regulated. The sale of current generated under such conditions could be made at a comparatively low cost to the consumer, and therefore the advantages would be mutual.—"Electric Railway Review."

The Hamilton Powder Company, of Nanaimo, B.C., have recently increased their electrical outfit by the addition of a 30 horse power 900 revolutions per minute Allis-Chalmers-Bullock induction motor.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Is a triple pole circuit breaker, with one current coil and one potential coil, a satisfactory equipment for a three phase induction motor?

Answer.—As a matter of actual fact, a breaker like this, assuming that both coils control all three arms, will be satisfactory under the great majority of conditions, that is, it will protect the motor against serious overloads, and will also disconnect it from the line should the voltage fail. On the other hand it will not protect the motor nor the circuit against trouble which might occur in that phase of the motor which does not contain the current coil of the breaker, nor will it operate if the voltage should come off those two phases across which the potential coil is not connected. These, however, are exceptional cases which will not be met with very frequently. On the other hand, it is the duty of protective apparatus to look after the unusual as well as the usual troubles, and so, properly speaking, you should have two overload and two low voltage coils, in fact the Underwriters, if they were brought into the question, would probably insist upon this.

Question No. 2.—Can I measure the power consumed by a small three phase motor with a single phase meter? I have lots of these, but do not want to buy an expensive polyphase meter.

Answer.—If your single phase meter is of the commutating type you can do this very simply by connecting the current coil into one of the three phase line wires, the potential coil being connected across the other two lines. If your meter is of the induction type you will have to get a small resistance box made in order to get a neutral. This is comparatively inexpensive, and can be got from the maker of the meter. In both cases, unless special direct reading dials be put on, you will have to multiply the meter readings by three. You must remember that the use of any single phase meter on a polyphase circuit is only possible when the latter is balanced, that is, when the voltages, currents, and power factors are the same for all the phases. Strictly speaking, this is never exactly the case, even with a polyphase motor as the load, but the error is not likely to exceed 1 per cent. or 2 per cent.

Question No. 3.—In using rubber covered wire in conduits, do I have to have two braids, particularly with twin wires?

Answer.—The National Code requires two braids on all wire for use in unlined conduits, the only deviation being that in No. 1 and larger a tape may be substituted for the inner braid. This, while known in the trade as single braided material, is satisfactory for use in unlined conduits. For lined conduits only one braid is required, but this class of material is comparatively seldom used in this country. For twin conductors all you need is one braid on each and then one enclosing the two wires, not two on each.

Question No. 4.—What is the test for vacuum in an incandescent lamp? I sent some in to a warehouse the other day, which I thought were bad, but just by looking at them they told me that the vacuum was good, and I afterwards found that this was right, and that the trouble was that my voltage was high.

Answer.—There are several tests for vacuum in incandescent lamps, namely, the way in which the lamp burns and the temperature it reaches, the degree and kind of discoloration of the bulb and filament, the way in which the filament vibrates, and then the glow test. A very dull red filament when the lamp is lit, especially if accompanied by a hot bulb, or a cold filament which appears a dead dull black all over, the bulb sometimes having a yellow deposit more or less all over it, are all evidences of bad vacuum. Then again most filaments when in a good vacuum will vibrate quite freely if the lamp be shaken, the effect being very distinctly seen by taking two similar lamps, one good and one with the tip off, and knocking them together. The filament in the bad vacuum lamp will come to rest almost immediately, while in all probability the other will vibrate for some appreciable time. This test is the one most generally used for all ordinary inspections, though it should be noted that it is not entirely infallible, because loose anchors, filaments of certain classes, and twists in filaments, will sometimes stop the vibration almost immediately and thus give a false impression. The only real and absolutely accurate test is to put the lamp across the terminals of a fairly high volt induction coil, the filament being connected to one terminal and the bulb to the other, through a resistance, consisting usually of another lamp. There will then be more or less of a discharge from bulb to filament, the amount and color being an infallible indication of the vacuum. This test of course requires apparatus seldom found outside of a lamp factory or else a laboratory.

Question No. 5.—What is a balancer coil, and what is it used for?

Answer.—A balancer coil is simply a reactive winding, for instance the secondary of a standard transformer, placed across a given two wire alternating circuit, taps being brought out at suitable points so as to divide the original two wire voltage into as many sections as are desired. Their most general use is in the first place in connection with two wire 220 volt alternating plants, in which case they can be placed anywhere round the premises where any other fractional potential is desired, the usual object being to get a 110-220 volt three wire circuit for the operation of lights, the motors being run from the two outsides. They are also used for exactly the same purpose, namely, to get a 110-220 volt three wire line, with 220 volt direct current plants, but in this case have to be placed near the generator, receiving the necessary alternating current from it by means of two slip rings and a special pair of leads. Obviously they cannot be placed at any point round the plant, as in alternating systems, because of the fact that the lines are direct current, on which the balancer would of course become simply a short circuit.

POLYPHASE POWER MEASUREMENT

Mr. C. A. Adams read the following paper before a recent meeting of the American Association for the Advancement of Sciences.

The point of view presented below has been employed by the writer for the past eight years to demonstrate the validity of the two wattmeter method of measuring three phase power, and has also been found useful in many other problems of power measurement, single phase as well as polyphase. The whole thing is so simple and so natural that it was for some years assumed to be familiar to other workers in this field, and although everyone to whom it has been mentioned has found the point of view novel, and most of the text-books employ algebraic or graphic proofs which apply only to particular arrangements of circuits, the writer still feels that the point of view must be familiar to others, who perhaps do not consider it sufficient without the confirmation of algebraic proof. It is all contained in the following paragraph:

In any n-wire system (direct current or alternating current, balanced or unbalanced), assume one wire as a common return for the other n-1 wires, considered as carrying the outgoing currents of n-1 separate circuits; and connect n-1 wattmeters as if to measure the powers in these n-1 separate circuits. Then the algebraic sum of the readings of the n-1 wattmeters will be the total power of the system. That the statement as given above is entirely sufficient without further proof seems almost self-evident, but will be made more clear by the following illustrations:

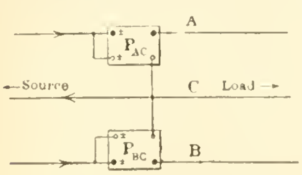


Fig. 1.

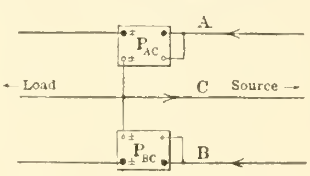


Fig. 2.

In any three wire system, label the three wires "A," "B," "C," as in Fig. 1. The currents in "C" counted backwards towards the generator are at each instant equal to the algebraic sum of the currents in "A" and "B" counted outwards from the generator, i.e., "C" may be looked upon as a common return for "A" and "B."

Imagine the "C" wire to be sub-divided longitudinally into two parts, one the return for the "A" current, and one the return for the "B" current; then it is obvious that the system is entirely equivalent to a two phase or two circuit system, one phase or circuit carrying the "A" current and the "AC" voltage, and the other the "B" current and the "BC" voltage, and that the two wattmeters measure the powers in these two phases or circuits, independently of any question of the balance of the system. No assumption whatever is made as to the actual arrangement of the circuits beyond the wattmeters, the equivalence to the two circuit arrangement being equally valid in all cases. In fact, any proof based upon the assumption of a particular arrangement of circuits does not ordinarily hold for any other arrangement.

One very practical advantage of the point of view here adopted is that the wattmeters may be readily connected into the circuits, without trial, in such a manner that the algebraic sum of their indications will be the total power of the system. If when so connected one of them gives a negative indication, it shows that its reading (when the connections to its pressure coil or to its current coil are reversed) should be taken with a negative sign.

This point is illustrated in Fig. 1, where the two wattmeters are connected to measure the power delivered by a source on the left to the load on the right,

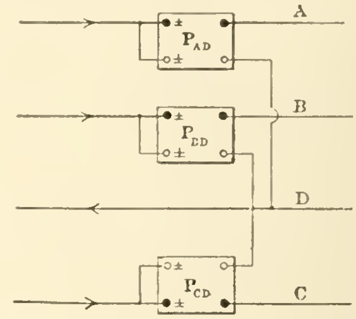


Fig. 3.

and where the corresponding terminals of current and pressure coils are designated ± (being such that if the line and pressure currents when counted inwards at these terminals are both positive or both negative at any instant, the corresponding deflecting moment will tend to produce a positive reading of the instrument). If the terminals are not thus designated by the maker of the instrument, they can easily be distinguished by experiment and marked once for all. Other instruments by the same maker will ordinarily have the same arrangement of terminals.

With this understanding it is evident that the two wattmeters of Fig. 1 are connected so as to indicate positively the powers delivered through the two phases or circuits (of which "C" is the common return) to the load on the right and that neither of these instru-

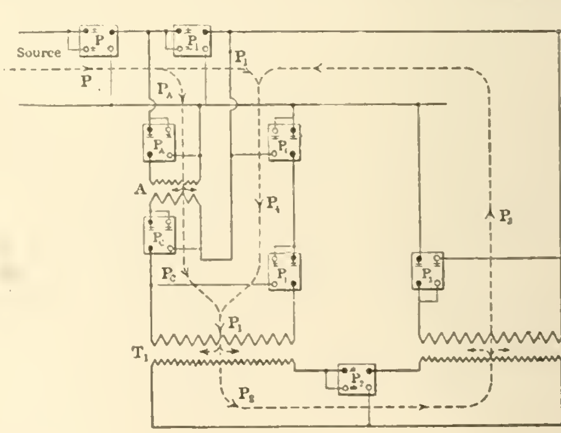


Fig. 4.

ments will give negative indications unless the power delivered through its circuit is actually negative, i.e., unless the flow of power in this circuit is from right to left, or from the load back to the source, instead of the reverse. In a balanced three phase system this means, of course, a power factor less than 0.5 or a lag in each of the three load phases greater than 60 degrees.

This illustrates another advantage of this point of view, namely, the emphasis it places upon the direc-

tion of power flow in any alternating current circuit and its relation to the manner of connecting in the wattmeters.

As an additional illustration, take the case of a three wire generator on the right, delivering power to a load on the left. The direction of power flow is reversed from that of Fig. 1, and the wattmeter connections should accordingly be reversed, as shown in Fig. 2.

As another example, let it be required to find the total power and its direction in any four wire system. Consider any one of the wires as a common return for the other three, assume the power to flow from left to right, and connect in three wattmeters to measure the powers in the three circuits as in Fig. 3. If the sum of the indications of the three wattmeters is positive with this arrangement, the total power flow is from left to right, and the assumption on this point is correct; but if the total indication is negative, the power flow is from right to left. In the case of a four wire two phase system, it would, of course, be possible to measure the power with only two wattmeters, but the above is perfectly general for any four wire system, either alternating or direct.

This point of view also adds meaning to the arrows often used in alternating current circuits to indicate the direction of the current.

Even in single phase problems this point of view is very helpful. A good illustration is the pumping back method of testing two similar transformers, as shown diagrammatically in Fig 4. T_1 and T_2 are the two similar transformers, and A is the auxiliary transformer. If the latter is connected as a booster, the flow of power in the several circuits will have the directions indicated by the arrows, and the magnitudes of these powers will be positively indicated by the wattmeters when connected as shown.

If the auxiliary transformers, "A," be connected as a depresser, the direction of the circulating power will be reversed, and the connections of wattmeters, P_1, P_2, P_3, and P_4, should be reversed. In an actual test, one, or at most two, wattmeters would, of course, be sufficient, the others being here inserted to illustrate the point in hand.

The writer realizes that even in the case of this last illustration there would be no real difficulty in connecting up the wattmeters by the ordinary cut-and-dry method, but he feels very strongly, nevertheless, method here illustrated is a great advantage, espethat the clearness of understanding involved in the cially to students, and hopes that the brief presentation given may prove helpful to others as well.

$2,600 IN PRIZES FOR AN ELECTRICAL SOLICITOR'S HANDBOOK.

Announcement was made at the National Electric Light Association Convention in Washington, June 7th, that by general agreement a change had been made in connection with the prize contest for the best electrical solicitor's handbook. The time when all competitors must have their work turned in to the Co-operative Electrical Development Association, Cleveland, Ohio, has been extended to October 1st.

The prize money has been placed in a bank where it will draw interest until the time of award, the winners to get not only the prize money, but also the accrued interest.

A pamphlet giving full details regarding this contest may be had upon application to the Co-operative Electrical Development Association.

THE DIRECT CURRENT AND INDUCTION MOTORS.

The direct current shunt wound motor and the alternating current induction motor have many operating characteristics that are alike in kind, but some of them differ in degree. Both motors require provision against a heavy rush of current through them when first connected to the supply circuit. The armature of the direct current motor is so low in resistance, however, that it constitutes practically a short circuit when at standstill. The induction motor winding is also of rather low resistance, but it contains so many convolutions and the magnetic leakage is such that when connected to an alternating current circuit its inductance keeps the rush of current considerably below what it would be with direct current. Because of this, a comparatively large induction motor may be thrown in circuit without damage to itself. It does take a heavy "gulp" of current for a moment, but nothing like the rush that would go through a direct current motor of equal output.

When in operation, both motors drop slightly in speed as the load increases, and vice versa. This is due to precisely the same cause, namely, the need for more current in the armature, and the necessity of reducing the counter electromotive force in order to get it. Variations in the impressed voltage also affect the torque of both types of motor, but in different degree. The torque of an induction motor will vary as the square of the voltage applied to its terminals, while the torque of a direct current motor is affected very slightly by ordinary variations of impressed voltage. This difference is due to the fact that the iron in the field magnet of the direct current motor is so highly magnetized that the field strength does not change proportionally with changes in the magnetizing current, while the reverse is true of the induction motor. The torque of both machines is proportional to the field strength and the armature current. Reducing by 10 per cent. the voltage at the terminals of an induction motor will reduce its magnetic flux 10 per cent., and this will reduce its rotor current 10 per cent.; hence, the torque will be reduced 19 per cent. With a direct current machine, the 10 per cent. reduction in impressed voltage would reduce the field strength much less than 10 per cent.—usually 3 or 4 per cent.—and this would reduce the counter electromotive force and allow more armature current to pass, thereby tending to keep up the torque. Hence, when carrying a heavy load, the induction motor is much more sensitive to changes in voltage than the shunt-wound direct current machine.—"Power."

Messrs. J. Knox & Company have installed a producer gas plant for the operation of their electric light system at Stayney, Ont. The plant consists of a 100 horse-power Fairbanks-Morse vertical multi-cylinder engine, and a 100 horse-power suction gas producer. The engine is of the vertical type, occupying little room, and is said to give regulation as close as can be obtained for the best steam engine.

THE ELECTRIC PLANT AT EAST TORONTO

In the summer of 1904 the Corporation of East Toronto, Ont., decided to build a power house and install an electric plant. The power house, shown in the accompanying illustration, is a brick structure, and the electric plant contained therein serves the purpose of supplying both light and power, the water-

Power House, East Toronto, Ont.

works system being operated by electricity. The consulting engineer for the work was Mr. John Galt, of Toronto.

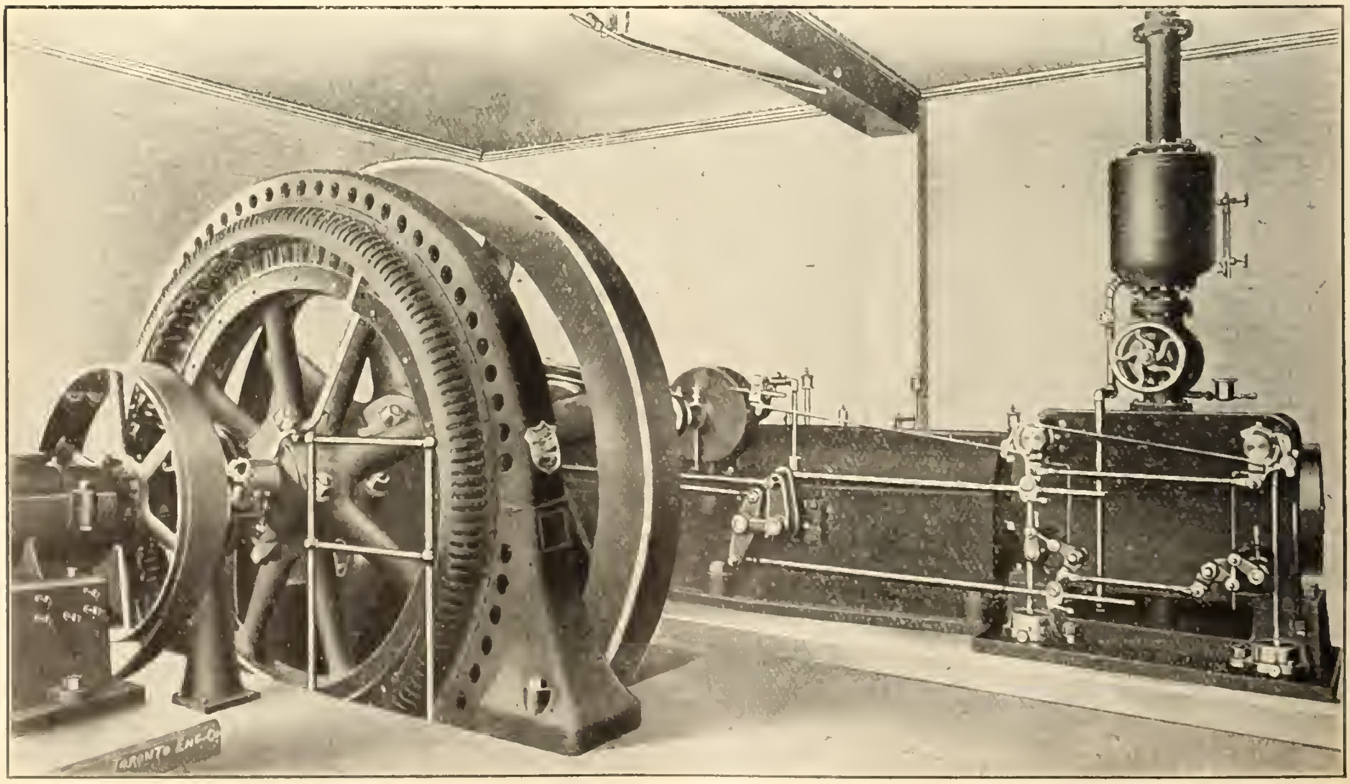
The engine is a single cylinder non-condensing Goldie Corliss engine, built by the Goldie & McCulloch Company, Limited, Galt, Ont. The diameter of the cylinder is 17 inches and the stroke 30 inches. The engine runs at a speed of 120 revolutions per minute. The rated load of the engine is 225 indicated horse-power, but owing to the double eccentric type of valve motion the engine is capable of carrying an overload of 60 per cent. above its rated capacity.

The engine is fitted with the Rites inertia governor, which is specially adapted for running high frequency alternators in parallel, and the flywheel is of sufficient capacity to enable the generator to be run in parallel with another 60 cycle machine. The field of the generator is mounted directly on the engine shaft, which also carries a pulley from which the belted exciter is driven.

The generator, which was furnished by the Canadian Westinghouse Company, is a 150 kw. 2,200 volt 3 phase 60 cycle revolving field machine, operating at 150 revolutions per minute. It has 48 poles, and the frequency is 7,200 alternations per second. The exciter is a 15 kw. 125 volt direct current multi-polar compound wound generator operating at 1,050 revolutions per minute. The switchboard is of blue Vermont marble, containing the usual instruments. The original installation comprised three transformers, 7,200 alternations, 2,080 volts primary, 575 volts secondary.

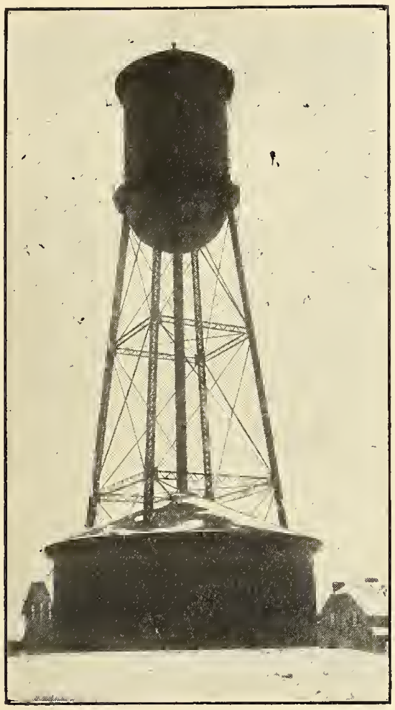
The turbine pumps and motors were furnished by the Canadian General Electric Company. There were in the original installation two 6 inch 3 stage turbine pumps, each having an easy capacity of 660 gallons per minute when operating against a pressure of 100 pounds per square inch. Each pump is direct connected to a 60 horse-power alternating current motor of suitable speed to operate the pumps against the desired head at maximum efficiency. When operating under exact conditions, as stated, the commercial efficiency of the pumps is guaranteed to be not less than 75 per cent.

The water tower, shown in the illustration, was furnished by the Canada Foundry Company. It is a steel tower with tank, the top of the tank being 120



View of Engine and Generator, East Toronto Municipal Plant.

feet above the top of the foundations. The tower is erected on steel trestle work over a steel reservoir 50 feet in diameter by 20 feet high, the top of the foundation of the trestle being on the same level as the



WATER TOWER, EAST TORONTO, ONT.

bottom of the steel reservoir. The capacity of the water tower is 80,000 imperial gallons, which is used for fire protection purposes exclusively, while the reservoir has a capacity of 200,000 imperial gallons.

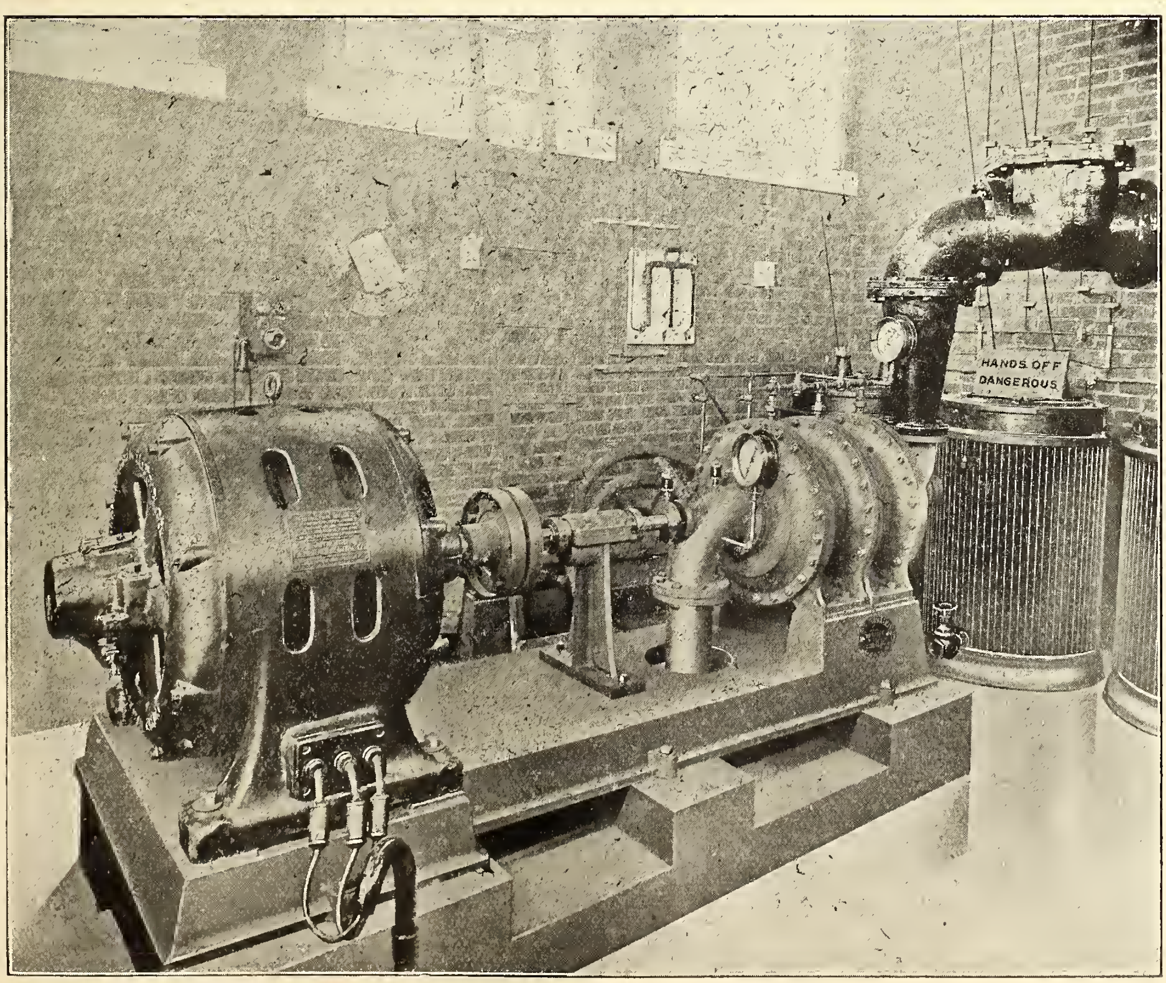
PLATINUM.

A company has been incorporated in London, known as the Platinum Corporation, with a capital stock of $1,500,000, to develop concessions in the platinum-bearing districts of Russia, which for nearly a century has been the producer of nearly 90 per cent. of the platinum supply of the world. Platinum sold in 1892 for less than $10 an ounce. In two years the price had risen to $18.50, and in December of that year it was $19.50. In April, 1905, it brought $20.50. It continued to advance until in February, 1906, it sold for $25. Last September it was quoted at $34. The top-notch price of $37 and $38 was reached in March, this year, and then the price gradually declined to $25 on July 1st. Three weeks ago there was an advance of $1.

Platinum is almost indispensable in the manufacture of incandescent electric lamps and is also required for contacts in telephone switchboards.

CIVIC PLANT TO BE ABANDONED.

The Board of Control of the City of Winnipeg has decided to abandon the city's electric lighting plant, and to purchase the current required from the Street Railway Company. It is claimed that the purchase of the power from the Street Railway Company will mean a saving of close upon 50 per cent. on the cost of generating it. At the present time the city is generating current for the direct current lamps, used for street lighting. These lamps number about 200. The city also supplies the power necessary for the wells except for the fire booster at well No. 2, which is supplied by the Street Railway Company.



VIEW OF TRANSFORMERS, MOTORS AND TURBINE PUMP, EAST TORONTO PLANT.

The Protection of Compound Generators Working in Parallel

By G. H. B. Bernard.

When a number of compound generators are required to work in parallel, feeding common bus bars, it is usual to protect them by means of an overload and reverse current circuit breaker on one pole and an overload breaker on the other. The object of this article is to show that equally good protection is afforded by the use of one circuit breaker only.

Let us first consider that side of the armature to which the series coil is connected. We see at once that since one terminal of each coil is connected to the equalizer, and the other to a bus bar, all the coils are in parallel, and form part of the external circuit, so that the current in one series coil cannot reverse unless the current in all the others reverses. Hence unless the current in all the others reverses. Hence between the series coil and a bus bar. A little consideration will show us that an overload circuit breaker so connected is equally ineffective. Since the coils are in parallel, and form part of the external circuit, the current in each coil is a definite proportion of the total bus bar current, and is quite independent of the current in the armature. To prevent any one coil taking an undue share of the bus bar current, it is only necessary to adjust the resistance of each series coil, by means of a series resistance if necessary, so as to make the voltage drop from equalizer to bus bar, when full load current flows in the coil, the same for each machine. When this is done, one coil can only be overloaded if the others are equally overloaded, so that either none of the series coils, or all simultaneously, should be disconnected from the bus bar. The only exception to this rule occurs when one series coil and the bus bar to which it is connected are simultaneously earthed, and in this case no current would flow through a cut-out connected between coil and bus bar. But the principal reason why a cut-out is useless if connected between series coil and bus bar is that, should the series coil of any generator be disconnected from the bus bar, its armature would still be in parallel with the remaining armatures, and since its voltage would at once fall considerably, due to the loss of its series excitation, a heavy reverse current would flow through the armature, and since this would act as an additional load on the other generators, already overloaded by the amount of the current previously supplied by the affected generator, the result would probably be a total shut down of the station. We thus see that a cut-out between the series coil and bus bar is not only not necessary, but might even, under certain circumstances, be actually dangerous. It is clear, therefore, that a cut-out on the series coil side is unnecessary.

We next turn our attention to the protection of the other pole of the generators. It is obvious that a reverse current circuit breaker is necessary to disconnect from the bars any generator whose voltage falls below that of the others, since the reverse current which consequently flows adds to the load on the remaining machines by an amount equal to the sum of the normal output of the affected generator and the reverse current flowing in its armature.

We next have to consider the advisability of making the circuit breaker operate on overload as well as on reverse; always bearing in mind the essential consideration that unless the breaker disconnects from the bars the cause of the overload, as well as the generator to which it is connected, it is worse than useless, inasmuch as by cutting out one generator it increases the overload on the remaining machines, and the entire station will in all probability shut down. The chief causes to which an overload on the armature may be due are the following:—

(1) The steady load on the station may be too great for the generators connected to the bars. As explained above, an overload breaker on each machine would be no protection to the station, and by running up a fresh generator the load on each can be reduced to its normal value.

(2) A short circuit may occur on a feeder. The extra load in this case would be shared more or less equally by all the generators, and the cut-out or fuses in the feeder circuit would disconnect the faulty feeder before any damage could be done to the generators.

(3) A short circuit may occur in the armature itself. In this case the volts generated by that machine would fall, and the machine is disconnected by its reverse current circuit breaker.

These are the most usual causes of overloads on the armature, and in each case an overload circuit breaker is a disadvantage. Other possible causes are:—

(4) A short circuit may occur between the bus bars.

(5) A short circuit may occur between the equalizer and the bus bar of opposite polarity.

The result of either of the above would be a heavy load on the entire station, which would continue until the short burnt out, or the entire station shut down.

(6) An armature coil and one bus bar may be earthed simultaneously. The result would be that an extra load would be thrown on the station, which would take the form of a sinusoidal current superimposed on the total output, and the overload would continue until the faulty coil burnt out, when the armature would be at once cut out of circuit by its reverse current circuit breaker.

An examination of the causes of overload will show that it is practically impossible for overload circuit breakers to disconnect from the bars the cause of overload, without successively disconnecting all the generators. It is for this reason that many engineers prefer to do without overload circuit breakers on their generators, relying on the generator reverse current breakers and the overload devices on the feeders to protect the generators. Practically the only cause of overload which is not adequately dealt with by this arrangement is a short between bus bars. Although such accidents are extremely rare, they are not impossible, and, if an overload breaker is used as a protection against them, it should be either set very high or provided with a time limit, or both, since the breaker is required to act only in the case of enormous overloads, e.g., that due to a short between bars, of

such a nature that the generators cannot safely be left to burn them out.

To sum up, a set of compound generators working in parallel and feeding common bus bars will be adequately protected if the series coil resistance between equalizer and bus bars is so proportioned that the full load voltage drop is the same for each coil, and the other side of each armature is protected by an automatic overload and reverse current circuit breaker, which will open (1) instantly when the reverse current reaches a predetermined value, usually 10 per cent. to 20 per cent. of full load current, and (2) after an interval of from one to five seconds (according to the overload capacity of the generator), when the forward current reaches a value equal to about four times full load. The ends of the series coil may with advantage be connected through a double pole switch to the equalizer and bus bar. There is then no chance of the generator being paralleled in with the equalizing switch open. And, finally, it is entirely unnecessary to connect an automatic cut-out between series coil and bus bars.—"Electrical Engineering."

A PERMANENT LEAK WATER LIGHTNING ARRESTER.

A water lightning arrester constructed at the Treforest station of the South Wales Electrical Power Distribution Company, near Pontypridd, is described in the "Electrical Engineer," London, May 31st, by Lewis W. Dixon, who designed and installed it. Two horizontal water pipes are provided for flow and return, which are connected to the neutral of the generators and the station earth plate. To each of these pipes three vertical pipes of glass tubing are connected, joined at the top to a special piece of glass tubing shaped like an inverted U, having a glass bulb in the centre, into which the point from the line wire dips. Connection at this point is made watertight by a conical plug of India rubber. The flow and return through this loop of glass tubing represents a maximum resistance for one of the three lines of 700,000 ohms. There are three rising and three descending pipes. This resistance, with the potential of 6,800 volts that exists on the system, gives a leakage of about 100 amperes for each pipe. This resistance can be definitely altered if desired by connecting up any one of the rows of metal sockets which form the joints between the sections of glass tubing. The sections are provided with gunmetal stuffing box with rubber insertion and a cable connector for making ground connection if necessary. In this way the leakage current for each pipe may be varied from one one-hundredth to one twenty-fifth of an ampere. The lines, in addition to the water arrester, are protected by Wurts spark gap arresters.

The negotiations entered into some months ago by the city with the Peterboro' Light & Power Company for the purchase of the electric light plant has fallen through. The company refused to go any further with the matter unless the Ontario Hydro-Electric Power Commission agreed to sanction any agreement entered into by the ratepayers and the company. The Council has decided therefore to apply to the Hydro-Electric Power Commission to acquire water power privileges and construct the necessary works to supply power.

MONTREAL STREET RAILWAY TO HANDLE FREIGHT.

Because of the increasing difficulty in securing carters to expeditiously handle freight in Montreal, the question of extending to the street railway the privilege of handling freight has recently been mooted in that city and has behind it the influence of many shipping houses as well as prominent builders and contractors. A resolution bearing on this subject was adopted a short time ago by the Montreal Builders' Exchange and was presented to the City Council. It read as follows:

"Whereas, it has been stated in the press that at the recent Council meeting on June 26 last, a petition was presented on behalf of leading city merchants, asking that the Council consider the desirability of permitting the Montreal Street Railway Company to handle freight throughout its city lines and connected systems;

"And whereas, the fact is indisputable that the congestion of freight, owing to lack of sufficient cartage facilities, offers a serious menace to the commercial interests of this city; and furthermore, that owing to climatic conditions, there is little probability of seeing any substantial increase in the present cartage facilities;

"Be it resolved, that this association, representing the important public interests involved in the building industry of Montreal, cordially endorses the proposal to relieve the constantly recurring congestion of freight traffic, and respectfully asks the City Council to make the matter one of urgency at its next Council meeting, in order that an amelioration of the present state of affairs may be inaugurated without delay."

Furthermore, the directors of the Builders' Exchange, in view of the fact that the matter of granting such a privilege to the street railway involved considerable difficulty, suggested:

"1.—Extending to builders and other large handlers of heavy freight, the privilege of having temporary sidings laid wherever the building or material is of sufficient importance to warrant it, thus avoiding all obstruction to passenger traffic. On smaller, or only temporary jobs, the the use could be met by unloading on skids by means of air compressors, derricks or other rapid devices. It should be borne in mind that for its own construction needs the street railway is already using large construction cars for handling heavy freight, such as sand, crushed stone, bricks, lumber, cement and structural iron, without hindrance to the passenger service, as the latter cars always have the right of way. This committee is not advocating the handling of small packages, as these properly come under the sphere of the express companies. After careful investigation, the committee doubts if the exclusive handling of heavy freight at night, as has been suggested in some quarters, is feasible or desirable, owing to the impossibility of securing night working gangs, and to the increased risk of accidents.

"2.—The maximum freight rates not to exceed the current rate for carload quantities charged presently by chartered cartage companies.

"3.—A fixed percentage of the gross freight receipts to accrue to the civic revenue."

In response to the efforts being put forth by the Building Exchange and the city merchants, Alderman Lariviere has stated that he will in the course of a couple of weeks present a by-law authorizing tramway companies to carry freight in Montreal.

THREE-WIRE DYNAMOS VERSUS MOTOR BALANCES FOR THREE-WIRE CIRCUITS.

In a paper on this subject read at the recent Electric Light Convention, Budd Frankenfield pointed out the following advantages possessed by the motor balancer over the three wire generator:

It can be regulated, either manually or automatically, to maintain equal voltages on both sides of an unbalanced system; it will carry a neutral overload with good regulation; it permits the use of standard apparatus throughout the plant, while the three wire machine is special and requires special equalizer arrangements for parallel operation; it does not seriously increase the cost of switchboard equipment and connections, as compared with the old two-dynamo arrangement; two-wire dynamos of over-all voltages may be added to a three wire plant without any change in their construction; the danger of violent short circuiting when "throwing in" a three wire dynamo in parallel with another does not exist when motor balancers are used; the balancer may be located either in the generating station or at any point out on the distribution system.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

The 1907 Electric Inspection Act

The new Electricity Inspection Act, passed in March last, is naturally based very largely on the original statute, which dates from 1894, though there are several important amendments, based of course on experience gained during the intervening period. These changes divide themselves into three groups, namely, new clauses added, old clauses altered and complete clauses left out. In the first group we find, and it is typical of the growth of alternating work, that a definition of frequency has been inserted, together with a detail of the permissible variation, which is given as 4 per cent. Further on, under the heading of Offences and Penalties, it has been found desirable to put in a section bearing on tampering with meters, or the wires leading thereto. It is of course to be regretted that such is necessary, though we may still congratulate ourselves that the beating of meters is not nearly as prevalent with us, having due regard to the relative numbers in use, as it is in the States. Another new clause which apparently indicates that the political hand has not been idle in the inspection field is that relating to the qualifications of inspectors. It is now required that all prospective candidates shall pass a qualifying examination, which is a most excellent provision and one that we trust will be carried out to every reasonable extent. One of the main clauses which have been left out entirely is that relating to chemical meters. These therefore are no longer a legal instrument, unless they are equipped with dials, a proviso that prohibits the only type that was ever used to any extent in this country, namely, the Edison. However, there are practically none of these now left in operation, so the change will not have any material effect upon Canadian meter practice, though it is very interesting as marking the passing of what was once a favorite and widely used device. Another omission is that of the requirement specifying that all meters must be equipped with disc observation windows, though as this was originally issued among the Departmental regulations, and not in the Act itself, it may be the intention to still retain it in the same place. It would certainly seem desirable that the section still remain in force, otherwise no meter, once it was sealed, could be checked without first breaking the seal and taking off the cover, a most inconvenient and expensive process. Further, the user would have no check whatever upon creeping. There are two or three sections that appear in more or less the same form in both Acts, and which are worthy of particular notice. One is that specifying that a copy of every meter reading should be left with the consumer at the time that the reading is taken. This clause is but little known, and one that is in consequence but seldom observed. Then, in addition to the information previously called for, name plates must now state the frequency of alternating meters. This of course is very desirable, and has always been standard practice, but in addition thereto all plates might with advantage give the watt hours for each disc revolution, which would bring all meter calibration to one standard basis, a most desirable reform. We understand that, at the time the revisions were first under consideration, that it was the intention to put in some such requirement. Another point which might be gone into with advantage is that

of meter tests. The Act itself is very indefinite as to this, simply stating that the error is to be not more than 3 per cent., but saying nothing as to the percentage load at which the test shall be made, the voltage, power factor, etc. Perhaps supplemental regulations will be issued which will clear up this point. Another clause to which attention might be drawn is that prohibiting the using of uninspected meters. It is of course known to the great majority of operating companies that inspection is obligatory, still there are probably hundreds of meters in use which are not yet sealed, particularly in the West. The penalty is fairly severe, namely, $25 per meter. The above covers obviously only some of the main points. The new Act was published in full in the May issue of The News, and we would suggest that all operating men peruse it carefully, as it is naturally incumbent upon all those concerned in the supplying of electric light and power to be familiar with the details of that Act, which, along with their charter, constitutes and defines their legal rights and responsibilities.

Single Phase and Three Phase Transformers

As is well known to the electrical art, a given amount of material can theoretically be made to produce a larger three phase output than if it be combined to make a single phase machine, the principle being best recognized in our practice in connection with generators and motors. It is equally true, nevertheless, of transformers as well as of these other devices, in fact the point has been recognized in European practice for some time back to such an extent as to make three phase transformers almost the standard there now. The main advantage is decrease in cost, both in original outlay and in operating expenses, because not only is a given output obtained with decreased material, but also, on account of this lesser amount of material, the losses are smaller. Besides this there are several other points, such as economy in floor space, decreased labor in handling, smaller weights, simplified wiring, etc., etc., all of which tend to the one and the same end, namely, better economy. On the other hand, the three phase transformer has some disadvantages as compared with three single phase transformers used as a polyphase group, otherwise the latter would have been obsolete long ago. First of all comes the question of providing against interruptions to the service from transformer burnouts. In a polyphase equipment this can be done either by a complete spare transformer, or else, if it be of the core type, by extra coils. Obviously in either case the cost is greater than for one single phase transformer, besides which the time consumed in making the repairs is likely to be much longer, a point that is frequently of more importance than the actual cost. As compared with this the combination equipment, being composed of units which are very standard, can be replaced in whole or in part in but a very short time. This one point alone, namely, the question of standardization and with it that of easy and quick repairs, is likely to remain the controlling feature, and to make the combination equipment the favorite over here for yet some time to come. On the other hand the lower cost which can be obtained by the three phase form, when built under similar conditions as to quantity, etc., combined with the better operating efficiency, will doubtless gradually bring it into use for the moderately high potentials and the larger sizes, though it is probable that for what is generally known as the pole suspension design the single phase unit will remain standard with us for some time to come.

A Code of Ethics for Electrical Engineers

At the recent convention of the Institute, held at Niagara Falls in June last, a committee appointed for the purpose, composed of Messrs. S. S. Wheeler (chairman), H. W. Bucke and C. P. Steinmetz, brought in a report which marks more or less of an epoch in the electrical profession, namely, a Code of Ethics to govern the actions of electrical engineers. The report was prefaced by the statement that while the committee felt it impossible to formulate a set of recommendations which would govern all the details which may arise in the intercourse between an electrical engineer and those with whom he has business relations, still they did think it practicable to lay down rules which, though couched in general language, would form a guide sufficiently comprehensive to meet most situations. The Code is divided into six sections, the first being devoted to general principles and the balance to the relations between the electrical engineer and those with whom he deals, namely, his client, the general public, etc., etc.

In the main the Code simply lays down in printed form those general laws which any and all honest men try to follow, consciously or unconsciously, whether they be legal, or medical, or electrical. In addition to these there is a division devoted in the main to the rights possessed by an engineer to general designs and drawings or other data which he must of necessity gather in the course of his daily labors, this being one of the most valuable sections, tending as it does to establish and set forth in definite form professional practice on what is often a difficult point. The section relating to the standards of the profession is interesting, though it is difficult to see how the title of consulting engineer can be limited as described, a consulting engineer being one who is open for engagement in consulting work, whether or no he be capable of satisfactorily performing that work being another question entirely. There is one clause that is a perfect travesty upon ordinary common honesty, let alone the standard which is supposed to be reached by all professional men, and that is the one which states that an engineer employed by any one man or organization may not accept commissions from those dealing with his principals. Surely the general sense of decency possessed by the engineering fraternity, electrical or otherwise, has not fallen to the point indicated by this clause. The statement relating to standardization has been criticized somewhat severely, still after all it is not a good sound principle to use as a general guide. Of course standard designs will not meet all situations, still they will meet a great many for which special materials are so frequently insisted upon. If at all reasonably practicable they have every other argument in their favor, being obtainable in far less time and at materially lower costs than special designs, besides which repair parts and complete duplicates can be had with the minimum delay and with the least possible chance of mistakes. The Code is on the whole a valuable product on the part of the Institute, and one which we commend to our readers as worthy of careful consideration.

Electricity as it Affects the Fire Department*

By F. A. Cambridge, City Electrician, Winnipeg, Man.

In making a few remarks on the above subject, I have divided them under two heads, in one of which I would consider electricity as a possible help to you in your work, and in the other as a possible hindrance.

In using the term "electricity" I will apply it, not only in the sense of its being an agent, performing the varied duties to which we harness it, but also to cover its transmitting and translating mediums; the wires, apparatus and various appliances that we have in daily use and which, properly or improperly installed or handled, renders electricity either a good servant or one capable of working a good deal of mischief.

In considering the helpful agency of electricity, you will naturally give first place to the fire alarm telegraph system. It is interesting to notice from what crude beginnings the present wonderfully accurate and yet simple and complete systems have been evolved.

Previous to the use of the electric telegraph for signalling purposes, towns and cities had to depend upon the alarm bell, rung by watchmen who were supposed to be on the lookout for indications of fire. The approximate locality was, in the larger cities, given by a code of numbers struck on the bells. Fortunately in those days our large cities were not as closely built up as now, nor were the buildings of such dimensions, so that delays of a few minutes were not so likely to mean so much to the fire department as they do now.

In June, 1845, there appeared in the "Boston Advertiser" a letter from Dr. W. H. Channing calling attention to a new application of the electric telegraph, to which heretofore notice had not been drawn, viz., that it could be used as a means of sending in alarms of fire between the different fire stations of the city, as well as striking the alarm on the various church bells.

The matter dragged on until in 1851 Dr. Channing forwarded an elaborate plan to the Board of Aldermen of Boston, being followed by a successful demonstration, resulting in an appropriation of $10,000 being voted by that city for the purpose of installing the system.

As may be imagined, the boxes and the apparatus were not so well suited to the purpose as those of today, and considerable doubt existed even in the minds of the inventors as to the certainty of the transmitting machinery. Printed directions instructed the citizen as follows: "Turn the crank within the box, say ten times, not too fast; then wait. If the signal is perfect, you have now registered the alarm. If the alarm has been heard at the central office the operator will indicate the fact to you by striking the number of your district on the small magnet bells in your box. Should you not hear this, turn the crank again, more slowly. Should you not then hear the response, go to another box, and if equally unsuccessful there carry the alarm yourself to the central office."

These directions were not followed to the letter, it may well be imagined, as excited individuals generally turned the crank as fast as they could, and not only entirely destroyed the legibility of the signal, but often placed the apparatus out of business.

Gradually the system was improved, the fundamental patents being granted Channing & Farmer in 1857. Various improvements followed in the relays, the shunting of the magnets by the closing of the outside door and, in 1859, for an automatic system in which the central office was dispensed with and all the bells and boxes placed on one circuit. This was called the "village system," on account of its adaptability to small places where the expenses of keeping trained operators on hand would be prohibitory.

Gamewell & Company installed their first successful plant in St. Louis in 1858, that city being the third to adopt the fire alarm telegraph. Mr. Gamewell had fully recognized the necessity (if the new system was to be as widely adopted as he hoped) of perfecting the signal box to a high degree, and to aid him in the work surrounded himself with men of inventive and mechanical skill. Three of these have made their names to be remembered for many years, viz., Messrs. Gardiner, Crane and Rogers. Patent after patent was issued, covering one improvement after another, until to-day the system has been brought to a state of perfection that, given care, and with lines erected as they should be, is well-nigh perfect as a certain and reliable means of transmitting intelligence of the outbreak of that ever-to-be-feared element, fire, to extinguish which you are ever risking your lives. Time being one of the most important elements in the success of your efforts, warrants the use of every means possible to enable you to gain precious minutes, nay even seconds, in arriving at your objective point, and thus through the fire alarm telegraph system electricity is a great help to you.

Electricity is also of considerable advantage in the facility with which the engine rooms can be lighted at a moment's notice. Through its agency not only is the current furnished to illuminate the buildings, but the automatic electric switch at the first blow of the gong turns on the current, while the electric door locks aid you again in saving seconds by facilitating a "hitch up."

Electricity has also been employed to operate numerous forms of automatic fire alarm systems. It is unfortunate, but true, however, that with possibly one or two exceptions these have not proven so reliable as to commend themselves to our favorable notice, the trouble seeming to lie in the corrosion of contacts. A system employing mercury for the closing of the electric current has, however, proven satisfactory, I believe, and deserves to be experimented with.

The auxiliary fire alarm system for the protection of large buildings is a valuable aid, as it enables the occupants to turn in the box from any number of different points and, with the use of the electric annunciator board at the entrance of the building, gives you the particular floor from which the alarm was sent.

The telephone should not be forgotten in enumerating your aids to prompt service. I will not attempt to

*Paper read at the Western Canada Fire Chiefs Convention, Winnipeg, July 16th, 1907.

discuss the merits and demerits of the telephone as a means of sending in an alarm of fire, simply stating that about one-half of the alarms received in this city are telephone alarms.

All boxes bought by this city for the last year or two are fitted with a telephone jack. It is proposed to equip a number of boxes with this device, and it is hoped that we will, by plugging in a portable phone, be able to furnish the officers of the department with a means of talking to the operator on duty; in this way special calls could be sent in for extra apparatus. The system would also be very useful for testing purposes.

In the development of the various electrical services that form so important a feature in our towns and cities, certain features may be considered as forming a possible hindrance to you in your work. Of these the overhead wiring systems on our streets are certainly a serious menace. While with proper supervision aerial wiring systems may be erected and maintained so as to offer a minimum of danger to the public under ordinary circumstances, still in business districts, where the room for hoisting ladders is limited, the wires are often in your way and in the hurry of hoisting apparatus perhaps their deadly nature is not sufficiently realized. Fortunately in this city our department has so far escaped serious injury through this cause, though I am afraid that before we reach the day when the wires will be placed underground fatal accidents will occur.

In cutting wires that are in the way of the department, the greatest care should be taken not only to protect your own men in clearing the way but to protect the public. A high tension wire cut at one point only and left hanging is liable to not only be within reach of persons on the wet ground but may cross various low tension wires, and through them send the deadly current over scores of wires into a large number of buildings, some of which may be miles from the point of contact. If in these buildings fires were to take place, caused by the high tension current escaping to ground, you might be seriously hampered by having to draw off part of your forces. I would suggest that where it is necessary to cut live wires that two men be set to work simultaneously at opposite ends of the stretch of wiring you wish to cut down—each man cutting the same wire at the same time, starting with the bottom wire and working up to the top. This will be found the safest way of working. The wires should always be cut within a foot of the insulator and the live ends "snubbed" back so as to avoid slacking back. A familiarity with the location of the different wires will also be valuable. If your fire alarm wires are likely to be affected try and avoid cutting these at all costs.

Interior electric wiring may hamper you by reason of the danger of getting shocks from same, due to your being wet and therefore liable to be good conductors. The Underwriters' Rules require a "service switch" at the point of entrance of light and power wires in every building. Familiarity with location of these will enable you to cut off the current in building affected.

Electrolysis of underground pipe systems is one of the most serious dangers a fire department is exposed to in all cities where electric railways operate, unless sufficient care is taken to prevent its action. I have yet to learn of a city on this side of the Atlantic that took steps early enough to prevent this destructive effect manifesting itself. In some cities the railway companies voluntarily guard against this evil, perhaps not so much to protect the pipes as to save money themselves, as electrolysis of underground pipes to any considerable degree always represents the dissipation of energy in a form that is not likely to yield big dividends.

In Great Britain very stringent rules are laid down by the Board of Trade to guard against electrolysis, and all roads operating are made to conform to certain requirements; the condition of the return system is always under test and must be maintained up to a given value. Had our Canadian cities adopted such rules when incorporating the various street railway companies, much loss would have been avoided, and your most valued ally, the waterworks system, would have been protected from the sometimes slow but in any case certain destructive action that in some instances only manifests itself in a burst of a main and a reduction of the pressure on most important occasions.

I sincerely trust electricity will not so affect any fire department represented here, but will, by its energy being properly directed, always render you good service.

ELECTRICAL SHOW AT MADISON SQUARE GARDEN.

The opening of the Electrical Show at Madison Square Garden is announced by President George F. Parker for September 30th, 1907. All the larger interests in the electrical trade are taking a keen interest in this exhibition, and the management expect to put forth their best efforts to interest the trade and interest laymen in the latest and most up-to-date electrical appliances, inventions and devices.

Since Ben. Franklin experimented with the clouds and discovered electricity, practical minds have harnessed this marvelous and mysterious power and have turned it into a commercial and domestic servant. At the Electrical Show will be exhibited everything from a miniature one-eighth of a candle power incandescent lamp to a ten ton dynamo.

Madison Square Garden will be laid out on a plan that is unique. There will be three avenues, Edison avenue, Westinghouse avenue, and Franklin avenue, running from east to west, with three cross streets running from north to south. The interior will be decked with 300,000 electric lights rivaling Dreamland in its resplendent glory. At each corner goose neck lamp posts will mark the intersections, and a magnificent arch in a blaze of incandescence is to mark the main entrance. Every exhibit will be fitted up with all kinds of wireless appliances connecting with stations now in vogue.

The New York Edison Company, one of the largest exhibitors, has in mind a plan for the exterior decoration of the Madison Square tower. It is to be one solid bank of lights, and this blaze of incandescence, it is expected, will surpass even the Dreamland Tower in brilliancy.

Electric Railway Department

SOME SUGGESTIONS ON INSTALLING TELEPHONE DISPATCHING SYSTEMS FOR ELECTRIC INTERURBAN RAILWAYS.

By George S. Hastings.

Basis.

Finding that many interurban railways are having more or less trouble with their telephone dispatching system, the writer has been investigating the subject with a view of ascertaining the best practice in the hope that this data will be of some value.

As many of the leading interurbans have adopted stationary telephone instruments located in a booth at each siding or passing point (usually from two to five miles apart) this article will be confined to this system.

General Arrangement Overhead Construction.

The arrangement of telephone lines for electric railways will be influenced by the following:

First—By legal restrictions regarding height, which in Ohio and New York State call for:

17 feet clearance over private road crossings.

18 feet clearance over public highway crossings.

25 feet clearance over railroad crossings.

Second—Minimizing induction by keeping telephone lines as far away from high tension lines as possible.

Third—The latter distance is limited by height of poles, which vary from 35 feet to 40 feet, probably 75 per cent. of interurbans having adopted 35 foot poles.

The accompanying drawing shows typical pole line construction.

Cross Arm.

Referring to drawing it will be noticed cross arm is 6 feet long, 4 1-4 inches by 3 1-4 inches, Norway pine. Arm has six pins, two for direct current feeders, one for Blake signal line, one blank, and two outside pins for telephone lines, which should be run horizontally parallel, as when run vertically parallel they are much more apt to give trouble.

Wire.

For lines less than 50 miles long use No. 10 (Birmingham wire gauge) galvanized iron telephone wire. This weighs 273 pounds per mile. The present market price of ordinary No. 10 galvanized iron wire is 3 7-8 cents per pound; cost of extra No. 10 galvanized iron wire is 5 cents per pound. About 75 per cent. of the small telephone companies use ordinary No. 10 BB wire. Western Union and Postal companies use extra No. 10 BB wire, which has 15 per cent. less resistance than the regular BB wire.

For lines over 50 miles long use No. 10 (Brown & Sharpe gauge) hard drawn copper telephone wire, this being the lightest copper wire that will stand up under sleet, etc. This weighs 165 1-2 pounds per mile, and costs 27 5-8 cents per pound.

The relative cost per mile (prices as of April, 1907) would therefore be as follows:

Ordinary No. 10 BB galvanized iron wire at 3 7-8 cents per pound $10.58

Extra No. 10 BB galvanized iron wire at 5 cents per pound 13.65

Copper wire, No. 10 (B. & S. gauge), at 27 5-8 cents per pound 45.72

The relative resistance at 75 degrees F. will be as follows:

Ordinary No. 10 BB iron wire, 21.15 ohms per mile.

Extra No. 10 BB iron wire, 18.08 ohms per mile.

Copper wire, No. 10 (B. & S. gauge), 5.28 ohms per mile.

Cross Arm Braces.

Cross arm braces are steel, galvanized, 26 inches by 1 1-4 inches by 1-4 inch. Pins are locust. Standard pin is 1 1-4 inches by 8 inches. Transposition pin is 1 1-4 inches by 9 inches.

Insulators are white glass, Hemingray or Brookfield, designed for long distance work. Standard insulator weighs 16 ounces. Transposition insulator is in two pieces.

Transposition.

The Independent long distance telephone standard is to transpose every 1,300 feet, but when lines are run close to high tension lines this will have to be determined largely by experiment. The writer recommends every 500 feet, using single pin transposition.

Wire Joints.

All joints should be made with the greatest care, as this is where most trouble is apt to arise. Iron wire should be joined with Western Union joints having 3 inch neck well twisted, and eight close wraps at each end, soldering two turns in neck, using acid in preference to soldering paste. Three wire joints are to be avoided. For copper wire, McIntyre or Standard American whole and half sleeves should be used. Combination whole sleeves should be used for connecting wires of different sizes altogether. (Since this article was prepared the writer has been reliably informed that the Bell Telephone Company has abandoned the use of sleeve joints on copper lines and has returned to the use of three wire joints carefully soldered. For iron wire, however, the foregoing recommendations hold.)

Tie wire should be of same size and material as line. For iron wire use a horseshoe tie around insulator, wrap three turns on each side and leave end 1 inch long hanging downward. For copper, use Independent long distance standard "Running Tie" 20 inches long.

Sag of Wires.

Wires should be run with a uniform sag which will vary with temperature and span.

The following table gives, for different spans of wire, the amount of sag in inches for different tem-

peratures from thirty (30) degrees below zero to one hundred (100) degrees above zero Fahrenheit:

Sag in inches for different spans.

Temperature.	75 Feet.	100 Feet.	130 Feet.	150 Feet.	200 Feet.
—30 degrees	1	2	3½	4½	8
—10 degrees	1½	2½	4	5	9
10 degrees	1½	3	4½	6	10½
30 degrees	2	3	5½	7	12
60 degrees	2½	4½	7	9	15½
80 degrees	3	5½	8½	11½	19
100 degrees	4½	7	11	14	22½

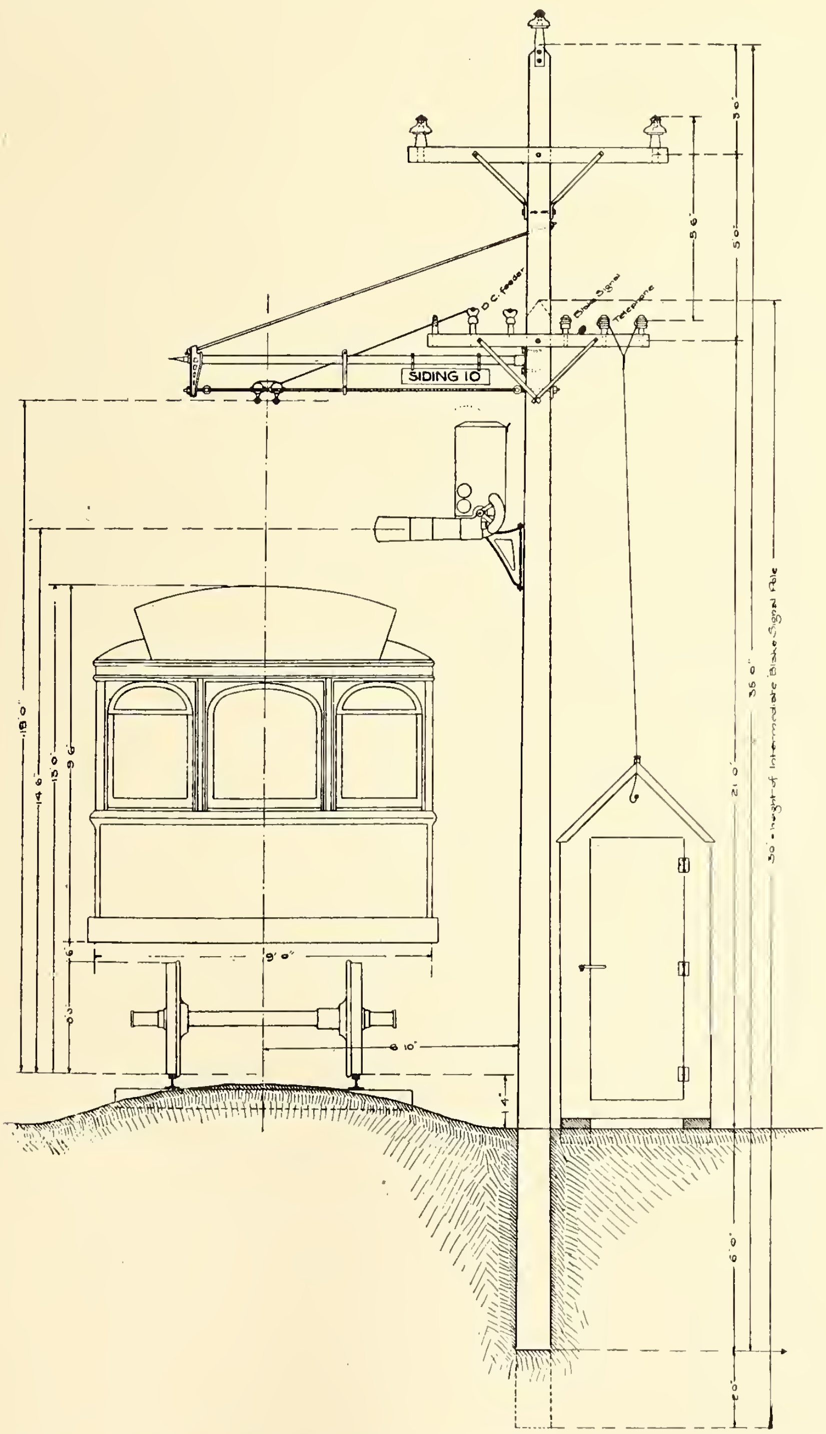
Iron wire should be less, in ratio of 7 to 9.

Drop.

Connect each telephone to line with a bridge drop of fully soldered to same. Extend drop to telephone booth; anchor to same with a porcelain insulator; enter booth by a porcelain tube insulator and connect to baby knife switch described below.

Telephone Booth.

The booth should be steel, covered with corrugated iron, or wood about 4 feet by 4 feet by 7 feet 5 inches high to square of building, with A roof, see drawing herewith. Building to rest on reinforced concrete sills. Padlock same as switch locks. Building to have southerly exposure, and to be lighted with a five lamp cluster operated by a door switch or some other safe type, to avoid danger of handling 500 volts by hand switch.



Suggestion for Standard Arrangement of Overhead Construction on Interurban Electric Railways.

No. 14 (Brown & Sharpe gauge) copper rubber covered braided and saturated duplex wire. Top ends should be secured to lower groove of insulator and carried from there with a small amount of slack to main lines and wrapped with six long wraps and care-

Telephone Switch.

A two pole baby knife switch should be located inside telephone booth on door jamb, so as to necessitate cutting out switch in order to shut door. To provide against door accidentally slamming against and

damaging the switch, the switch should be placed so as to cut out in this event.

FUSE.

In circuit between switch and telephone, located directly above latter, insert a pair of 2 1-2 ampere 600 volt fiber incased fuses on two pole block, to protect operator, phone, etc., against accidental high tension ground, lightning, etc. A stock of extra fuses should be kept on hand.

TELEPHONE.

The telephone instrument should be compact dry cell type, oak woodwork, five bar generator, 1,600 ohm ringer, the batteries of which will require renewing about every twelve months. No shelf is required.

RECORDING ORDERS.

Install an autographic register with capacity of 1,000 5 inch train orders in triplicate, 4 5-16 inches, 6 1-2 inches or 8 inches wide by 5 inches long.

Register should be flush with a shelf 20 inches wide by 13 inches long, back placed 46 inches above floor, set at same pitch as machine, and having moulding at lower edge to hold pencil, etc. This will bring edge of triplicator flush with back of telephone centrally located in booth described above, preventing order sheet from being obstructed by receiver and providing good arm rest for wiring while telephoning.

EMERGENCY PHONE.

If deemed advisable a portable phone with jointed pole connections to line can be added to car equipment. This should be tested frequently and be spring suspended in car to minimize jarring.—"Electric Traction Weekly."

STANDARDIZATION OF ELECTRIC RAILWAY EQUIPMENT.*

By C. B. KING, Manager London Street Railway.

The word "standard," like the word "arbitration," the expression "municipal ownership," and some others, has a very peculiar and subtle effect upon one, especially when an effort is made by a travelling salesman, a labor agitator or a politician to be captivating. When we hear the word "standard," the impression is immediately conveyed that the most nearly perfect has been obtained and that there need be no further argument. But as perfection is impossible, complete standardization is likewise impossible from the fact that about the time we adopt a standard, an improvement is made which we must adopt, and so we lose our standard. There are, however, certain elements, consisting almost entirely of dimensions, in our present electric railway equipments, which can be successfully standardized, for the reason that so many similar parts of so nearly the same sizes have been in use so long that our experience has shown that one set of dimensions can be selected that would suit all. It is to this class of standardizing that my interest inclines, and to which I beg to call your attention. A great deal in this line has already been done by the Master Car Builders' Association, and by the American Society of Civil Engineers, which has been of benefit to electric railways, and which I think we should follow where possible or point out some good reason why we should not. Similar organizations to the Canadian Street Railway Association, such as the American Street and Interurban Railway Association, the New York Street Railway Association, and the Central States Electric Railway Association, have also done something, the most thorough and effective work having been done by the latter association.

The M. C. B. Association was impelled to determine upon its well-known standards because of their interchange of cars and the necessity of one road repairing cars belonging to another. Electric railways hardly need it for this reason now, but they will soon, because of the development of interurban lines and their several connections. But I think we have a reason which is very similar to that which caused the A. S. C. E. to determine upon rail sections, and that is, that we are getting so many motors of different designs which must be kept in repair. Each design has its own particular gear, pinion, bearings, etc., and so we must add to our stock of supplies, and thereby add to our store room difficulties. In order to at least reduce these difficulties, I beg to suggest that we classify motors and adopt standard designs for all the wearing parts possible. Electric railways are connecting, to an increasing extent, with steam railways, and so I think electric railway associations should adopt the M. C. B. standards as far as possible. The electric railway associations have enough to do to establish standards for the electric equipment, which, if they do their work well, will in turn be adopted by the M. C. B. Association when the steam railways adopt electric operation.

The Central States Electric Railway Association appointed a committee last September to recommend standards for various parts, and at its meeting last month, it reported upon the subjects of rails, wheels, journals, journal boxes, axles and brake shoes. I believe it is to yet report upon various other parts. As you have no doubt read the reports, as recently published in the journals, I will only review, with perhaps some criticisms, what it has suggested.

Its adoption of the 70 pound American Society standard rail for interurban work is all right for the present, but I have no doubt that the time will come when it will consider this rail too light, when, of course, it can adopt the next size, or the 80 pound American Society standard. Its adoption of a 7 inch high T rail for city work suits its local conditions, for most of the cities in that territory permit the use of T rail. However, I think a girder groove rail and a guard rail should be standardized, so that the repairing and replacing of track work will not be so troublesome and expensive as it is at present, when we find it very difficult to get rails of the same section as we may have in use at present. Two other things about track work, which might be standardized to advantage, are the tongue switch pieces and the frogs in the special work. As tongue switch pieces having a radius of either 100 or 150 feet are suitable for the beginning of curves of almost any radius, it would be a great advantage in the replacing of these parts if the radius of the tongue switch piece and its length were standardized, and so made by the manufacturers. The tongue should also be of the standard length, so that they will be interchangeable. In the frogs, the length of the arms is about the only thing that could be standardized, for then we should know that a frog

*Paper read before the Canadian Street Railway Association.

made for a 50 foot radius curve would fit at any intersection where there is a 50 foot radius curve, without regard to the length of the arms.

One more thing which I have in mind regarding track work, is that of paving block. Those of you who have had any experience with this kind of paving must have found how troublesome it is to do any patching if the old bricks are broken to any extent when track repairs have to be made, and you find the new block which you have to be of a different size. I am a believer in large paving blocks, for the reason that these blocks wear at the edges first, and therefore the less number of edges, the less will be the wear. I would suggest that a paving block 4 inches thick, 6 inches wide, and 12 1-8 inches long, would be a very good one for track work, the 4 inches in depth being enough to give it body, and being just about the right thickness for paving over ties with a 6 inch rail. The 6 inches in width would give a good broad wearing surface, while the 12 1-8 inches in length would be just right for fitting with two blocks laid sideways, if it should at any time be desired to lay them this way.

Coming back, for a moment, to the subject of rails, I have often thought that a good method of standardizing rails might be to adopt such rails as the American Society standards for all work in the country, in unpaved streets or roadways, and then to use this same rail in the paved streets or roadways by making what might be termed a compound rail, consisting of an upper section of the ordinary A. S. standard rail, and of a lower section consisting of a specially rolled eye-beam, very much like the Carnegie steel tie, having an upper flange of 4 5-8 inches, which is the same as the base of the 70 pound rail, a lower flange of about 6 inches wide, and a height of about 5 inches.

These two sections would be held together, at frequent intervals, by rolled steel clamps, bolted through the webs. By laying the two sections so that the joints of the upper section and the joints of the lower section would not come together, a very good form of continuous rail would be obtained, which would yet have sufficient joints to allow for the necessary contraction and expansion. Where a groove section rail is required, a very light guard could be rolled and bolted to the inside of the ordinary T rail. If it were desired to use a regularly rolled girder groove rail, one very similar to the Loraine Steel Company's section 80, No. 337, could be used and clamped to the lower section just as well. This method of construction would save ties, because a less number of ties would be necessary, and as the ties could be buried deeper in the foundation of concrete or otherwise if desired, the road bed should stand the wear better than when light rail is used and the ties are laid close under the pavement, and then when it became necessary to renew the rails, because of wear, only the upper section would have to be replaced. This would be particularly advantageous in special work at curves and intersections, for the reason that they wear so much more rapidly than rail on straight track. The amount of material used in the replacements would then be reduced to a minimum. The depth of the upper section, 4 5-8 inches, would still be sufficient to use the hard steel centres or the solid manganese pieces, as might be desired. All of these pieces, for special work, should have a section of a standard design, so that no matter what manufacturer they might be obtained from, the one would fit with the other, using the same kind of fish plates, or splice bars. This kind of track would, of course, cost from 25 to 50 per cent. more, but I believe that, in the course of 10 to 15 years' wear and repair, the benefits to be derived would greatly repay this difference.

With regard to the truck parts which might be standardized, I hope you will agree with the suggestion that as far as possible the M. C. B. standards be adopted to all those parts of the truck not influenced by the electric equipment. We cannot, of course, adopt the M. C. B. wheel, and so I think the one selected by the Central States Association to be the wheel which is about correct, being not too large for city work, and yet plenty large enough for interurban work. It has adopted the M. C. B. journals, making some of them smaller, of course, than those actually used by the Master Car Builders, but yet of the same design. It has adopted a brake shoe very similar to the M. C. B. design, and until I learn the reason for not adopting the regular M. C. B. design, I think the latter should be adopted, but, of course, the M. C. B. design would have to be modified to suit the smaller wheel, and if this is the only difference, the shoe it has adopted will, of course, be all right. The axles which it has adopted seem to be for heavier work than we are accustomed to in ordinary street railway work; however, I believe it might pay to adopt these heavier axles, even for light street car work, for there is no doubt that some breakage would be saved by doing so. I find very little reason for adopting the standard journal box, except in order that it may contain the standard journal, as the journal box itself wears very little, and is therefore not subject to frequent replacing.

When it comes to standardizing certain parts of the electrical equipment of cars, some difficulty may be encountered, for the reason that the two or three large manufacturers of railway equipment may want to maintain their individuality in certain details. However, as it is only the wearing parts which I propose to standardize, and such parts as are now so nearly alike, I do not see that this difficulty should be considered insurmountable. My desire for standardizing these parts is not so much that we may all use the same thing, as it is to make these wearing parts interchangeable between motors of different design, but of about the same size, and to this end I would suggest that those wearing parts be designed for three different sized motors, of 50, 75 and 100 horse-power sizes respectively. Motors ranging in horse-power under 50 would then be designed to use those wearing parts which would be just large enough for a 50 horse-power motor. Those motors rated between 50 and 75 horse-power would use wearing parts just large enough for 75 horse-power motors, but which, I think, would not be too large for anything between 60 and 75. I make the 50 horse-power class the smallest, for the reason that no modern street railway motors are now built of less than 35 horse-power, and I take it that the gears, pinions and bearings of a 50 horse-power motor would not be objectionably large for a 35 horse-power motor. Gears and pinions, beside being classed into 50, 75 and 100 horse-power sizes, would have to be also classed according

to gear ratio desired. Axle and armature bearings, however, could be simply classed into 50, 75 and 100 horse-power sizes, the motor frames being bored out for these respective sizes, and then if it might be desired to use a 50 horse-power motor in a two motor equipment on a truck having a smaller axle, the only difference would be in the cast iron shell of the babbitt-lined bearing, and the change could be readily made. Standardizing of motor parts might be carried even further to commutators and brushes, which, however, would require the same number of coils in the armature. Commutators of the General Electric and of the Westinghouse motors, of relatively the same size, are now so nearly alike that I see no reason why the armature shafts might not be turned to a standard size and the commutators likewise made of a standard size, so that one would be interchangeable with the other, and the same might apply to brushes, bearing in mind all the time that they are to be classed into the above mentioned sizes, or something similar. On our small road we have three kinds of motors all of approximately the same size, viz., G. E. 800, G. E. 1,000, and Westinghouse 92-A, and I think you can readily see what a saving in supplies to be carried on hand, and in the flexibility of repairs would be brought about were it possible to use the same gears, pinions, bearings, commutators and brushes on any of these motors. And if we would go this far, why might we not go the entire length of the rope and draw up complete specifications for motors of 40, 50, 60, 75 and 100 horse-power sizes, so that armature coils, field coils, and, in fact, all parts would be interchangeable? Surely the several master mechanics and electricians who have had many years of experience with the use of motors could get together and sift down their several opinions so that a motor design satisfactory to all would be obtained. Controllers should also be so constructed that the contact fingers, especially that part of the finger which wears the most rapidly, could be standardized so that they also would be interchangeable with any other controller of similar size. Trolley bases should be standardized with regard to pins, and the socket into which the pole is to fit, so that bases and poles would be interchangeable. If the sockets are standardized, of course the poles would naturally become so. Trolley harps and wheels should also be standardized, so that they might be interchangeable.

As before stated, my reason for desiring that these various wearing parts be standardized is to facilitate repairs and the expenses thereof, on any one road or system where it seems we cannot get away from several different designs of motors, and not so much simply for the sake of using the same size or styled parts that other roads do. However, I readily recognize that this state of affairs can never be brought about until such associations as our own, and others of like nature in the United States, get together, establish the standard dimensions necessary, and demand of the several manufacturers that they be produced. Of course, I understand that the manufacturers will object, as they may not then be in such a good position to continue supplying repair parts; however, I believe that if this matter is handled properly, that enough pressure can be brought to bear upon the manufacturers to produce the motors and parts as we want them. I am a little disappointed that the largest organization of the kind, the American Street and Interurban Railway Association, has not already taken hold of this subject more vigorously than it appears to have done, for I believe that the best results are to be obtained through action by the largest organization. However, if the minor organizations, such as our own, the New York State Association, the Central States Association, and others, take hold of the subject themselves, or urge upon the large association to take hold of it, the agitation of the subject and the work that may be put upon it can hardly fail to bear fruit, and we may ere long have the electric railway standards which will no doubt be commonly known as the E. R. Standards.

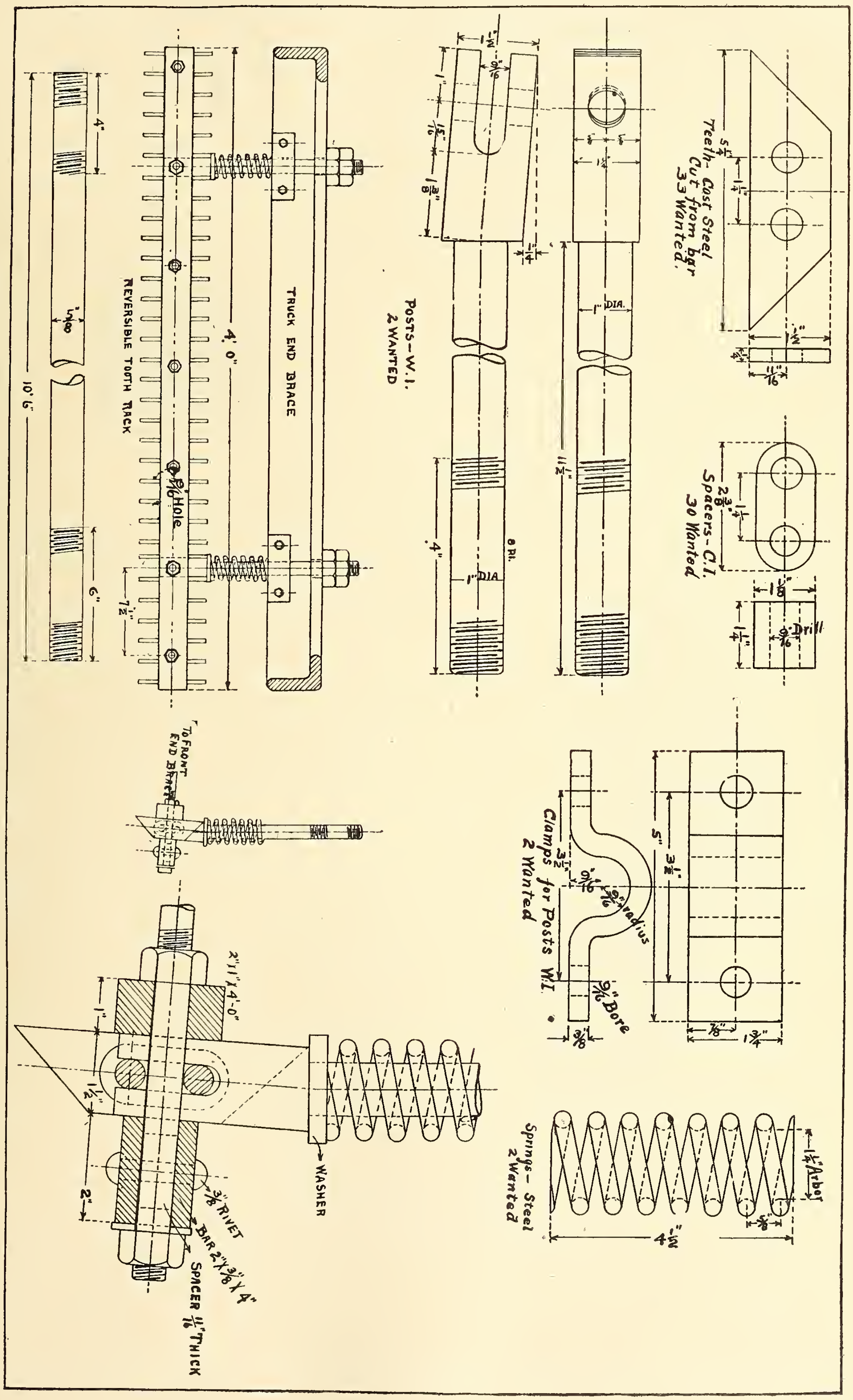
SNOW AND ICE CUTTING DEVICE.

The Montreal Street Railway has used successfully for three years a home-made ice and snow cutter which is attached to cars and is intended to keep ice and snow from packing in the track. On the opposite page are reproduced from the "Railway and Marine World" the working drawings for a cutter as adapted to the company's standard double trucks, but the device can be used on any kind of single or double truck. The teeth are cut from steel bars and last a season or more. The practice in Montreal is to have a sufficient number of cars equipped with the cutter from November to April, to insure that one of these devices will pass over all main lines every 20 or 30 minutes; that is, there is one cutter to every three or four miles of track according to conditions of street traffic. The device is intended not so much to shave down ice that has been allowed to form, as to prevent its formation by keeping the surface continually broken. The company does not find the use of the cutter necessary on branch lines where the street traffic is light, because the snow between rails is rarely packed sufficiently to encourage formation of ice between rails. The principal points to be observed in order to have the most satisfactory results are: First—Keep all cutters adjusted to a standard height above rail. Second—Attachment to truck should be made at random in order that teeth on different cars will not all gage into the same furrows. Third—Adjustment of distance from rails should be made periodically with the help of a straight-edge 2 1-2 inches or 3 inches wide, set across the rails under the teeth. No picking of ice has been necessary on the Montreal lines since the cutters were put into service, and the roadway between the rails is kept perfectly smooth and level at a uniform height above the rail. This is a very important factor in the operation of sweepers or plows.

ENGINEERING PARTNERSHIP.

Mr. E. H. Keating and Mr. Wm. H. Breithaupt have announced the formation of an engineering partnership under the name of Keating & Breithaupt, with offices in the Aberdeen Chambers, Victoria street, Toronto. They will carry on business as civil engineers, taking up all branches of railway and municipal work, power developments, bridges, etc.

Messrs. George Caverhill and Paul Galibert have been elected directors of the Montreal Street Railway Company.



SNOW AND ICE CUTTING DEVICE AS USED BY THE MONTREAL STREET RAILWAY.

POINTS ON CENTRAL STATION WIRING

In all electrical installations the power cables running from the generator to the switchboard, the connection that is made to the terminal board on the generator and to the stud on the controlling switch and circuit breaker, are of more importance than any other part of the station wiring. Should a breakdown occur at any of the above-mentioned places it has a great effect on the total output of the plant. If it is not possible to cut out a unit for a short time and let the load be carried on the balance of the generators, the result will soon be felt over the entire system. As trouble from faulty connections will only show up when the plant is running at its maximum load and when the power is needed the most, it is of greatest importance that the work of connecting up the power cables be done in a manner that will leave no room for doubt as to their behavior under heavy overloads.

In soldering large or small terminals to cables a few points are well worth remembering to obtain the best results. Terminals should be well tinned inside before using. A good way to do this is to put the terminal in a pot of hot solder until it is well heated, then withdraw the terminal and apply the acid or soldering paste to the parts to be tinned, and then fill the terminal with hot solder and pour out immediately.

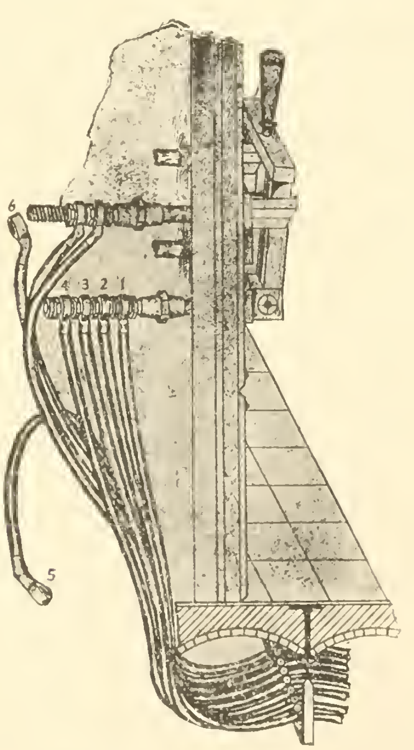


Fig. 1.—Showing Method of Connecting Cables to Switchboard.

This will almost always insure a good job of tinning. If it does not, repeat the operation, being careful that the acid and soldering paste does not touch any part of the terminal other than that which is to be tinned. If the terminal in question is too large to be submerged in a pot of solder, good results can be obtained by heating the terminal, applying the acid or soldering paste and then rubbing the inside of the terminal with "stick" or "wire" solder. A terminal should never be used until all of the inside is well coated with solder.

Cables as well as terminals should have their ends tinned before using. Perhaps the best and quickest way to do this is to dip the end of the cable in the acid or rub well with soldering paste, then dip the cable in a pot of hot solder. Should any of the end of the cable remain untinned, repeat the operation until there can be no room for any doubt as to a good job, shaking off any solder that may cling to the cable.

The proper location of cables is very important. Cables should be kept as far as possible from steam pipes or where there is escaping steam or leaking water pipes. Excessive heat will rot the insulation and also leave the cables in such shape that they are a danger to men making repairs on any part of the power-house equipment located near the cables. Water is a bad thing near cables, as there is always a chance of getting a ground due to "surface leakage." The above points apply more to cables which are supported by iron or wooden brackets than to cables which are run in clay or iron conduit.

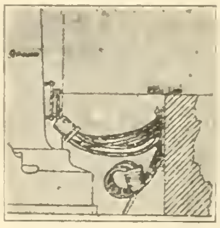


Fig. 2.

The principal points to remember in case the cables are run in conduit are to see that there are no bad joints where water or any foreign matter may enter; also, that there are no burrs in the conduit where the pieces are joined together. The best time to take off any burrs that may be left after a pipe is cut, is before the pipe is removed from the vise.

We have considered briefly the importance of the wiring, method of tinning terminals and cables, also the location of the cables and a few points to watch when conduit is used. Let us now assume that we have the cables in place and tinned ready to solder the terminals to the cable and fasten them to the circuit breaker or switch stud. One thing to watch is to see that the cables coming from the conduit or bracket hangers have the same amount of slack in them, so that when they are soldered and fastened in place they will all be in line. The safest way to accomplish this is to solder the terminal which is to be nearest the switchboard and on the lowest stud first. As for example in Fig. 1, terminal No. 1 should be put on first. Then Nos. 2, 3 and 4. If possible they should be soldered and put in place one at a time. That is, do not try to cut all the cables to just the right length without having any of them soldered in place. Great care should be taken that there are no nicks or burrs on the nuts for the studs, and that they are well cleaned with emery cloth and wiped with a dry piece of waste before being run on the stud. A good way to clean the contact surface of a nut or terminal is to wrap emery cloth over a block of wood large enough to be gripped by the hand and rub the terminals well; or lay a full size piece of emery cloth on a board and rub the terminal or nut on it. If the

emery cloth is held in the hand, there is a tendency to rub off the surface at the edges and thus lose part of the contact surface. If possible, the hands should not come in touch with the contact surface after the nut has been rubbed with emery cloth and wiped with a dry piece of waste. This last is a precaution one would hardly think necessary, but, as the workmen's hands at this time are apt to be very dirty and greasy, it is best to take this precaution to insure a clean contact. Wherever possible, a terminal should be placed upside down when it is ready for the cable to be soldered into it, as shown in Fig. 1 terminal No.5. Heat the terminal well and have it one-half or two-thirds full of hot solder. Then insert the cable slowly, keeping a torch applied to the terminal. If possible, the end of the cable should be heated first in a pot of hot solder until it is up to the temperature of the solder before placing in the terminal. If the stud is near the floor and the shortness of the cable will not allow it to be bent back, the cable should be pulled back in the cellar and terminal put on there. If it is a job where conduit is used and the cable can be pulled back far enough to allow for this, it should be done. If there is no way of soldering the terminal while up-

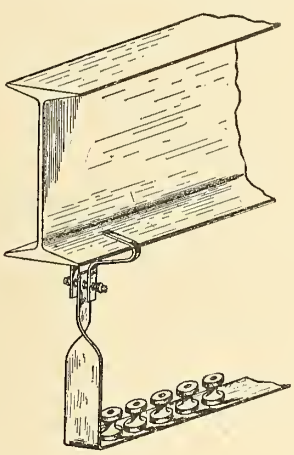


FIG. 3.

side down, then drill a small hole through the upper part of the terminal. place the terminal in position on the cable, wrap the cable and terminal well with tape and pour the solder in through the hole in the top of the terminal, keeping a torch on the top of the terminal until you are sure that the solder has had a chance to work its way all through the cable. The objection to this method is that one never knows when the cable and terminal are well filled with solder, for when one thinks he has it well filled, he generally finds the solder running out through the tape onto the floor. One other point to watch when the terminal is soldered to the cable and it is ready to be put in place, is to see that it goes on the stud so as to have the contact surface of the terminal parallel with the contact surface of the nut. Note in Fig. 1 terminal No. 6 should be straigtened up before going on the stud. If this point is carried out it will insure perfect threads and no undue strain on the marble panel when the nut is tightened up.

Fig. 2 shows a machine terminal with four cables soldered in it at the same time. In case of heavy work, where more than one cable is to be soldered in to the terminal and where the terminal is to be turned upside down, it is best to take one cable at a time. Cut it the right length and place in the position it will be when finished. Hold the cable in place by wrapping bare wire around the cable and terminal and tieing them together. Do this with each cable and as soon as they are all in place, tie them together and tie to the terminal. On a set of four large cables, it will require a good deal of binding wire to hold the cable in place so that the terminal can be turned over without having the cables get out of position.

After the cables and terminal have been properly tinned and tied together and the terminal is upside down, heat the terminal well with a torch (several will be required if the terminal is a large one), and then pour in the solder, giving it a chance to settle and shrink. Keep pouring in this solder until you are sure it has worked its way to the bottom of the terminal, all through the cable, and is flush with the top of the terminal. In this way one can be assured that, if the terminals and cables were properly tinned, there will be no trouble with the terminal carrying its load, provided the terminal itself and the cable are large enough. When placing the terminals on the terminal board, care should be taken to see that the contact surface of the terminals are parallel to the contact surface of the machine, so as not to allow any twisting strain on the marble or slate terminal slab. Often on a job of wiring in central station work, the engineer has to get his cables in as best he can, and is unable to take the time to buy any of the special insulators and insulator brackets that are manufactured for heavy station wiring. Fig. 3 is a good example of what can be made for a hanger for cables where one has to depend on his own sketches and a small blacksmith shop in which to do the work. This style of bracket or hanger is so simple that it will need no explanation. The size of the material used depends on the number and size of cables used and the spacing of brackets or hangers. In case braces are to be fastened to a wooden frame work, the top can be changed to suit conditions. For running cables along a brick wall, an arrangement such as shown in Fig. 4 can be used. All that is required in this case are the necessary expansion bolts and blocks of hard wood. The size of bolts and wooden blocks depends on the size and number of cables used. Wooden blocks should have two or three coats of insulating paint or varnish before being put in place.

Buyers of electric plants will be interested in a catalogue entitled ''Westinghouse Lamps,'' recently issued by the Westinghouse Lamp Company.

The Chase-Shawmut Company have just issued to the trade a very attractive fifty-eight page booklet, pocket size, covering their complete line of fuses, bases and fittings. In addition to their regular line, this catalogue presents a number of specialties which have recently been placed upon the market. Containing over one hundred illustrations and considerable valuable data, this catalogue will be eagerly sought by all interested in this class of material.

The D. Van Nostrand Company have recently published a very valuable book entitled ''Steam-Electric Power Plants,'' by Frank Koester. It is a treatise on practical principles involved in the design of light and power central stations, and fills a long-felt want. The author is an experienced power plant designer, having been closely affiliated with the design of plants in Europe, Asia, Central and South America, etc., as well as the construction and operation of plants of from 1,000 to 24,000 kw. capacity.

Synchronizing Rotary Converters

By Jacob Glogau, in Electrocraft.

When a rotary converter is started up by any of the three methods, namely (1) by use of the separate motor, (2) by using the converter as a direct current motor, and (3) by using the converter as an alternating current motor, it must then be in synchronism with the alternating current bus bars before it can be thrown in the circuit.

A machine is said to be in synchronism with another rotary when it is running with the same number of frequencies and in the same phase. By frequencies we mean the number of reversals of the electro-motive force in a given time, and by phase we mean that the armatures are in the same positions with respect to the field poles, and lastly, the voltage of both machines

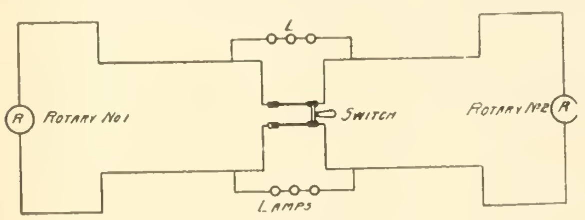


Fig. 1.

must be the same as recorded by a voltmeter.

The operation of synchronizing rotary converters with machines which are already in operation consists in bringing up the incoming converter to approximately the same speed as the one which is in operation, and also to the same voltage. When the machines have the same frequencies, phase and voltage there will be no unbalanced voltage when the machines are synchronized, therefore there will be no inrush of current.

In synchronizing machines there are generally two ways, one of these can be sub-divided into two divisions. The two ways are, (1) by means of lamps, and (2) by means of the automatic synchronizer.

Fig. 1 shows the principle of synchronizing; also one of the methods used.

(R) and (R) represent the two rotary converters, to be synchronized, and are connected through the switch by two series of lamps (L). As the phases are different in the beginning of the operation of synchronizing the lamps will therefore receive the maximum and minimum voltage through them, thus causing the lights to burn bright and dim as the changes in the phases vary. If the two machines are in phase then the electro-motive force of rotary No. 1 will oppose the electro-motive force of rotary No. 2, thus causing zero electro-motive force, or no light from the series of lamps; therefore it is clear that when the machines are in step the lights will be out and then the connecting switch must be closed.

A safe thing to remember in this operation is that the operator must be sure before closing the connecting switch that the lights (lamps) will not brighten up again (if this happens serious trouble will ensue), but must throw in the switch when all possibilities of pulsating phase is gone, that is to say, that the lamps should remain dim for about ten seconds before the switch is closed.

Another method, but still in the first way of synchronizing, is to use transformers, that is to say, instead of connecting the series of lamps directly on the line, they are placed in the secondary coil of the transformer.

Fig. 2 shows the connections.

In this method we use the shunt transformer, the primary coil (PC) being connected directly across the line and the secondary (SC) coils are connected in series with the synchronizing lamps, if the transformers are connected the same on the two circuits; then when the machines are running in phase there will be no light given off by the lamps, as there exists zero voltage. But if for some reason the primary coil of one of the transformers is connected differently from the primary coil of the other transformer, then the indication of the lights will be reversed, that is, when the machines are running in phase the lamps will be bright instead of dark; the same is true if the secondary coils of the transformer are connected differently. In practice the most commonly used is the dark lamp to indicate synchronism.

The objection to the lamp system of synchronizing is that it requires a large difference of phase to make the lamps glow, and secondly you cannot tell if the machine is running slow or fast. A synchronizing apparatus to be an ideal synchronizer is that which performs the following functions: It should tell if the machine which is to be synchronized is running fast or slow; it should indicate when both the machines are in phase, and should tell how much the machine is running fast or slow.

These functions are performed by a machine known as a synchroscope. This indicator is chiefly manufactured by the Westinghouse and General Electric Companies. The instrument is provided with two point-

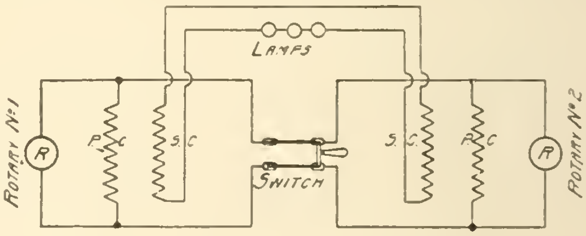


Fig. 2.

ers, one a stationary one and another which is movable. On the dial is indicated Fast and Slow, thus when the movable pointer is in the vicinity of the part of the dial marked Slow, then we know that the incoming machine is running slow, and vice-versa.

When the two machines are in phase, then the two pointers will be together; when the movable pointer slowly approaches the indicator needle (or stationary needle), then the operator gets ready to throw in the synchronizing switch.

To operate the synchroscope it is necessary to connect two shunt transformers between the instrument and the bus bars, and another transformer to connect the machines which are being synchronized.

Fig. 3 shows connections for use with a Westinghouse synchroscope.

The second class of synchronizing is that known

as the automatic synchronizer. This instrument consists of two solenoids, one of which receives the maximum current and the other receives the minimum current. To make this action possible one solenoid is connected similar to a lamp to synchronize with a bright light, and the other is connected similar to the lamp to synchronize with no light. When the machines are running in the same phase the mechanical parts of the synchroscope are in a certain position so that a contact is made which causes the operation of relays to the main syncronizing switch, thus performing the operation of synchronizing automatically. These machines or instruments have been found to do satisfactory work and are being rapidly introduced in central station work.

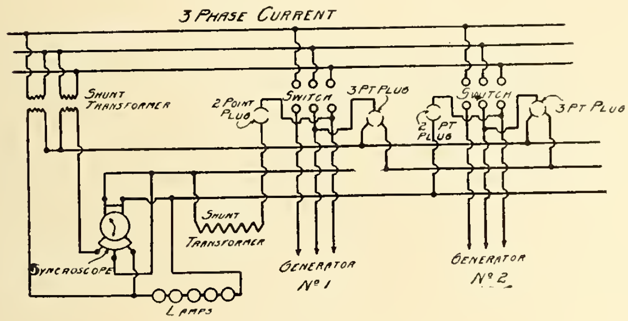


Fig. 3.

The operation of the automatic synchronizer is as follows: The main electric synchronizing switch is provided with two coils, one a closing coil and the other a tripping or opening coil; these two coils are connected to a three point switch, thus allowing the operation of either one and not both simultaneously. A switch known as the synchronizing switch is used to connect the two solenoids with the potential transformers, one solenoid taking current from the bus bars and the other from the incoming machine.

Fig. 4 shows connections of automatic synchronizer.

When the two machines are nearly in phase (allowing a few seconds for the operation of the switches) the synchronizer closes the circuit of the solenoid on relay switch and that promptly closes the closing coil circuit, thus operating the main switch which connects the incoming machine on the line. If for some reason the phases are changing too rapidly for parallelling, there is a certain attachment in the synchronizer which withdraws one of the contacts, thus preventing the closing of the relay switch. By the use of this instrument all possibilities of injuring the rotary converters are eliminated.

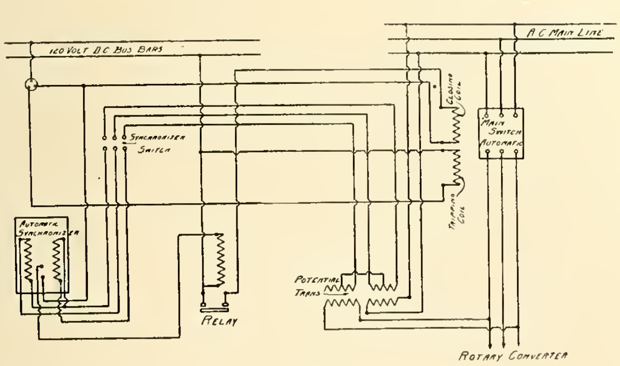


Fig. 4.

RIO DE JANEIRO TRAMWAY, LIGHT & POWER COMPANY.

The annual general meeting of the Rio de Janeiro Tramway, Light & Power Company was held at the offices of the company, Toronto Railway Chambers, Toronto, Ontario, July 2nd, 1907. The first annual report contains some very interesting information, an abstract of which follows:

"The company was incorporated in Toronto, under the laws of Canada, in June, 1904, to acquire and operate valuable concessions and privileges granted by the Governments of the Republic of Brazil and of the State of Rio de Janeiro and by the Council of the City of Rio de Janeiro, to carry on an electrical business in the federal district and in the city and state of Rio de Janeiro, and to acquire two great water powers, and construct and install the necessary hydraulic electric plants, and generate and supply electric current for purposes of traction, power and light.

"The water powers are situated: (1) on the Rio das Lages, 56 miles from Rio de Janeiro; (2) at Sapucaia on the Rio Parahyba, about 100 miles from Rio de Janeiro.

"After a careful examination of the situation, the directors decided to develop the former water power first, and to hold the latter in reserve, although at the time of coming to this decision it was believed that the Rio das Lages was only capable of developing 40,000 horse-power, while the Sapucaia power can easily develop 100,00 horse-power in the driest season.

"Since the commencement of construction the clearing of the banks of the Rio das Lages has disclosed that the reservoir formed by the dam which the company is building at Rio das Lages will have a much larger capacity than was anticipated, and consequently a much greater power can be developed, and, by a recent concession from the state of Rio de Janeiro, the company has acquired the right, if and when it desires, to tap the neighboring watershed of the Rio Pirahy, which will insure sufficient water to develop a total of 120,000 horse-power at Rio das Lages in the driest season.

"The company is the absolute owner of the banks of the Rio das Lages, from a point some distance from the power house, and extending up stream to the highest points to which the water will be backed by the dam, a total distance along the river of some 22 miles. The authority to use the hydraulic force of the river is derived from the common law right, as owner of the river margins, as well as from a concession of the Government of the State of Rio de Janeiro, the competent authority. This concession is in the form of a contract, is perpetual, and can not be revoked, and no additional onus or obligation can be imposed on the company.

"In this hydro-electric concession all state and municipal taxes in the State of Rio de Janeiro are fixed in one annual contribution for a period of 50 years; power is given to supply electricity throughout the state, and to all the cities and towns thereof, and it is expressly declared that if any new favor be in the future given by the Legislature to any hydro-electric enterprise, the same shall be extended to this company, and the obligations of the company in re-

gard to construction, operation, and maintenance of the works, are reasonable, and free from vexations restrictions. The company also owns all the necessary marginal land for a future development at Sapucaia, and the concession above referred to also extends to this enterprise.

"The company also acquired from the federal government and the municipal council concessions giving the exclusive right to furnish electrical energy, generated by hydraulic installation, within the city and federal district, and the right to construct and maintain an overhead and underground system of canalization for distributing the electric energy for power and light, subject only to certain rights of the gas company hereinafter referred to. After June, 1915, this concession continues, but without any exclusive right until 1950, but the ownership of the extensive system of underground canalization occupying all the principal streets practically insures the company against unreasonable competition.

"The directors deemed it advantageous to immediately construct at Rio das Lages a preliminary hydro-electric plant, and power from this source was made available for use within the city of Rio de Janeiro during March, 1907. The main upper fall of the river has been used for the purpose, and a temporary power house of wooden frame and corrugated iron was built. This plant has a capacity of 3,400 horse-power and will be utilized for furnishing all the lighting and power required for the construction work at Rio das Lages, as well as for supplying light and power in Rio de Janeiro over the permanent transmission lines which are already completed. Meanwhile, the main installation at Rio das Lages is being rapidly constructed. A concrete and masonry dam is being built at the top of the falls, 115 feet in height, and 92 feet in thickness at the base. This structure stands on a solid granite foundation, both at base and sides, and will close up the valley above, in which will be impounded sufficient water to guarantee under the present development a maximum load of at least 50,000 horse-power.

"The total area of the lake above the dam is about 7 1-4 miles. The water passes through controlling gates and riveted steel pipes 6,000 feet in length from the reservoir to the distribution receivers immediately above the power house. From the receivers are led out six 36 inch pipes about 1,900 feet in length, each to its own turbine. These pipes are laid on a steep grade, the receivers being located about 900 feet above the power station. The total head with the reservoir full is about 1,030 feet from the spillway level on the dam to the nozzles of the turbines, representing a pressure of 445 pounds to the squire inch. At the power house are being installed six main wheels, each developing about 9,000 horse-power maximum capacity, to which are connected generators of the stationary armature and revolving field three phase type, designed to operate at fifty cycles, with a normal voltage of 6,000, and a maximum potential of 6,600 volts. The voltage of current from the generators will be stepped up to 80,000 volts with a maximum overload potential of 88,000 volts for transmission to Rio de Janeiro over the four transmission circuits.

"The whole of the above work has progressed from the outset, and is progressing in the most satisfactory manner. Almost all the material is already, or will be immediately, on the ground. It is hoped that the first generator will be at work during the summer and all six before the end of the year.

"There are two separate lines of transmission to the city, each with two separate circuits, located on the private rights of way of the company, acquired by purchase. The company has constructed about 220 miles of underground canalization under the streets of the city and has built 69 large transformer and distribution chambers under the pavements and has already installed 350,000 feet of cable. This distribution system was brought into service on March 16th and operated satisfactorily."

The officers of the company are: William Mackenzie (Toronto), president; F. S. Pearson (New York), vice-president; Frederic Nicholls (Toronto), vice-president; Alexander Mackenzie (Rio de Janeiro), resident vice-president; J. M. Smith (Toronto), secretary-treasurer.

TO DEVELOP GRAND FALLS, N.B.

The Grand Falls Power Company, Limited, owns the exclusive rights for the development of the water power of the Grand Falls, on the St. John River, in the northwestern part of the Province of New Brunswick.

The plans for the hydraulic development of the falls have been made by A. C. Rice, of Worcester, Mass, for an initial development of 80,000 horse-power. This power, with the exception of Niagara, in the opinion of the best informed, is one of the largest and most advantageously located on the American Continent. The natural formation of Grand Falls is such that the cost of development will be extremely low—in fact, less than that of any of the large powers.

The St. John River in its course at this point approximates in plan the lines of a horseshoe, the deep inward sweep of its ends forming both an upper and a lower basin. The forebay and intake in the upper basin will be connected with the power house in the lower basin by seven tunnels, 12 x 13 feet, cut through the rock for about 2,000 feet. A dam of about 550 feet is to be erected above the falls, raising the water 14 feet. The falls themselves add 75 1-2 feet to this, and there is a fall in the gorge below the falls and above the lower basin of another 45 1-2 feet, giving a head at the power house of 135 feet.

It would seem, therefore, as if nature had intended that the enormous volume of water flowing down the St. John River should be made to do its share of the work of the present active constructive age and made it as simple a problem as possible for the engineers.

It is the present intention of the company to build a transmission line from their plant to the City of St. John, 170 miles in length. The plans for the transmission of power have been made by Ralph D. Mershon, who is generally recognized as one of the ablest transmission experts, and who is widely known for his connection with the development of the Victoria Falls of South Africa, where a 700 miles transmission of electricity is contemplated.

Methods of Securing Power Business*

By Geo. N. Tidd.

It seems to me that our attitude toward the power problem should be, that there is no reason why our plants should not furnish all the power used by manufacturers and others in the city, with possibly the exception of those manufacturers who use a larger amount of steam or heat in their process of manufacture; notably paper mills, who steam their pulp and use their engines simply as reducing valves.

An examination of the steam plant of the average manufacturer will show many examples of poor steam engineering and a high cost of energy delivered for actual production. One will usually find they are using comparatively expensive coal and frequently teaming the coal in and the ash out. They are probably purchasing their water from the city and feeding it to the boilers with injectors. The boilers are frequently poorly set and operating at poor efficiency. The engines are probably of inferior design, old and in poor condition; usually slide valves or high speed automatic, and in many instances either over or under loaded.

The frictional load of shafts and belts frequently will represent 20 to 50 per cent. of the power produced. Their labor cost will be high when considering the amount of power actually consumed in producing useful work. It would, therefore, appear, with our high efficiency generating plants, methods of burning low grade fuels, low labor costs (due to large outputs and labor-saving devices), together with the savings we can secure by the elimination of a larger portion of the frictional line losses due to motor drive, that we should take over all the power business of the district, and not confine ourselves to a comparatively few short hour, low loaded factor class of consumers.

As to some of the methods of attaining this desired end, I would suggest:—

First.—Secure the services of a good operating engineer for the work, a man, if possible, who has been in charge of a central station plant, and one who can appreciate quickly the points involved in good and poor steam engineering. This man should be a good salesman, and, with one or more assistants, can cover a good deal of ground by devoting his entire attention to the work.

There are many men operating the smaller plants who are admirably adapted for the work. The varied experiences secured by such men in operating these plants, with the numerous difficulties encountered and overcome every day, make them particularly resourceful and valuable for the work. I take my hat off, every time, to the man in charge of the average small central station plant.

Second—Canvass of District.—Have your power man make a thorough investigation of every power-producing plant in the district, no matter how large or small. Keep a systematic record of every case along lines suggested in a plant data sheet. A thorough study of each power problem should be made, which, supplemented with a study of the process of manufacture, will develop business that at first sight would be deemed impracticable to secure, owing to steam or fuel conditions. This analysis prepares the representative to meet the owner or manager, in a measure, upon his own ground, and having a close approximation to the total costs of the plant, conditions of operation and load factors, puts him in a position where he can talk and argue most effectively. His grasp of the situation is tremendously increased. These records are invaluable, as in some instances it is not possible to close a prospect until he has a breakdown, and when it comes all the data are instantly available.

Third—Secure a Large Representative Installation.—The first large customer comes hard. After the ice is broken, others have more confidence in your proposition and are easier to handle. It will, therefore, be of great aid to secure one of these customers to whom you can send and take prospects. The customer should, if possible, be one of the leading manufacturers. There are always one or more manufacturers in a district who are naturally the leaders, and others are very apt to consider whatever they do the proper thing. Make the most important manufacturer your friend and a booster; make his installation a model one, and you will find his aid invaluable. There is nothing so effective in arousing the interest and desire of a prospect as having him examine and see a large installation in operation, and talk with the owner or manager on the many advantages over the old steam drive.

Fourth—Trial Demonstration. — We frequently meet prospects who are dubious as to the advantages of central station drive in their particular business or conditions. They admit it is good for their neighbor, but for this reason or that, it is not suitable for them. In other words, they are from Missouri and "need to be shown." In these cases, I would install the complete equipment and furnish current to operate for 60 or 90 days' trial. Usually they will agree to pay a nominal sum, representing their acknowledged costs for the service, and in many instances will further agree to provide the motor foundations and belts. Under these conditions the expense of such a trial is merely nominal, as all the apparatus can be removed and used elsewhere. There are many advantages in such a trial.

First: The organization of the local steam plant will deteriorate, and in some instances vanish, so it is hard to get together another gang; the inertia of a change has been overcome, and you have it on your side in finally closing.

Second: It demonstrates much better than you can tell the advantages of close speed regulation, with its consequent increase in output, the freedom from plant troubles and worries, the flexibility and cleanliness, and, above all, gives you an accurate determination of the actual amount of power required to drive the plant under favorable conditions.

It has been the writer's experience that fully 95

* Paper read before the National Electric Light Association, Washington, D. C., June 7, 1907.

per cent. of these trial installations are finally closed.

Fifth—Methods of Selling.—Be liberal with your prospects in regard to terms of payment for the motors. In many instances it is advisable to sell upon the installment plan and allow one or two years to pay for the installation. The small manufacturer especially needs the money in his business and cannot afford to make the necessary outlay in cash for the proper installation. By taking a lease upon the apparatus and insuring it against fire, you are pretty well protected. In some instances it may be necessary to install a motor free, if it secures a particularly favorable business. The rate per kilowatt hour can be easily increased enough to cover the cost of the motor. In other words, allow nothing to stand in the way in the line of a reasonable investment in securing good motor business.

Sixth—Remember that every power prospect, especially if it be a large one, must be considered largely as an individual proposition. You cannot make a hard and fast system of rates which will apply to all cases. Do not be afraid to go down on high load factor business, simply because your present cost with its low load factor is higher than perhaps you will be called upon to quote. I would suggest dividing your costs up into readiness-to-serve and output expense; dividing the connected load into the total readiness-to-serve expense, and the output expense by manufactured current. This will give an indication of the value of high load factor business and what it can be sold for. Therefore, do not be afraid to go down on the long hour business.

Off-peak Business.

This class of business does not seem to have been given the consideration it deserves. Many stations believe it is not possible to secure any amount of this character of business. If, however, every power prospect be carefully analyzed and working hours studied, it will astonish you to find how much business can be secured on this basis. Wherever a manufacturer works two shifts it is usually possible to so arrange the hours that they will avoid your six o'clock overlapping peak. The proposition requires care in presenting to the manufacturer, for at first thought he will say that it is not possible, but if your man has his conditions thoroughly in mind (and he should not talk until he has) he can in many instances persuade the prospect to shorten the noon hour, start one-half hour earlier in the morning and shut down early enough during the winter months to avoid the overlap. For instance, flour mills can easily shut down during overlapping peak hours, foundries by getting out their iron somewhat earlier, and many others are in the same class. Flat rates in connection with this off-peak business work in very advantageously. I am aware of the prejudice of all central stations against flat rates, and to some extent I share this for unlimited flat rate lighting. However, I do not believe flat rate power business is in the same class. The manufacturer will not pay for labor or wear and tear upon machines simply to waste current. He has a clearly defined number of hours to operate, a certain maximum production to obtain in these hours, and a definite number of machines to operate. A flat rate peak load contract can thus be easily drawn which will cover the situation fairly well. Say nothing about the horse-power required. The company merely agrees to furnish energy in sufficient quantities to drive a certain number of carefully described machines a certain number of hours per day. The contract is very useful in landing certain classes of men and business which could not be otherwise obtained.

One of our Western plants in a city of 25,000 has now a day load of 1,500 kilowatts and has upon its circuits over 90 per cent. of the total power business in the city, the only exceptions being the paper mills. Another plant, in a city of 30,000, has a day load of 1,000 kilowatts and is closing down plants as fast as station capacity can be installed to take care of it. Fully 50 per cent. of the power contracts in both these cities contain this peak load clause.

The value to the central station of a good, heavy, long hour motor load cannot be over-estimated. It furnishes a steady income for every month of the year. The amounts received per customer are relatively large and difficulties of collection very small. customers, the most influential and best element of the city, and they will influence public opinion in your favor and largely minimize the danger of municipal This power business will represent a satisfied class of ownership agitation.

OHIO ELECTRIC LIGHT ASSOCIATION.

The 13th annual convention of the Ohio Electric Light Association will be held at Toledo, O., Aug. 20th, 21st and 22nd, 1907, with headquarters at the New Boody Hotel. The subjects of papers to be read are as follows: "Factory Lighting" (two papers); "Experience in Operation of Luminous Arcs" (one paper); "Co-operative Commercialism in the Electrical Field" (one paper); "Best Form of Power for Stations of 500 kw. Capacity or Less" (one paper); "Helps to a Solicitor" (three papers); "Best Ways to Meet Gas and Gasoline Competition" (five papers). In addition there will be reports on results with heating devices; high efficiency lighting units; uniform accounting, and cost determinations.

IMPREGNATION OF POLES.

William L. Hall, chief of the United States Forest Service, says that while the work of impregnating poles by the open tank or brush treatment has been too recent to permit the decay of the poles in any event, he is nevertheless prepared to say without hesitation that the increase in life of the poles will be more than sufficient to repay the cost of treatment. He adds: "It is well known that a thorough impregnation with a good grade of creosote will render wood immune to decay for a long term of years, and judging from the condition of the butts of the poles after treatment by the open tank process and from our knowledge of the antiseptic qualities of the preservative, there can be little doubt as to the securing of a decided increase in life."

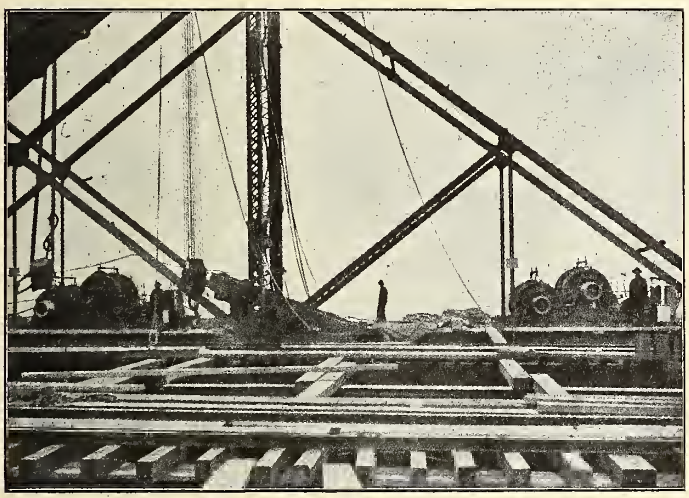
The contract for installing an electric light plant at Battleford, Sask., has been awarded to the James Stewart Company, of Winnipeg, selling agents for the Canadian Westinghouse Company. Arrangements have been made to have the work commenced at once.

BRIDGE BUILDING BY ELECTRIC POWER.

In the construction of the huge bridge across the St. Lawrence river at Quebec the entire work of erecting is being done by electric power. The bridge is being built for the Quebec Bridge Company, and the Phoenix Bridge Company, of Phoenixville, Pa., is doing the construction work. The bridge is of the cantilever type and will have a span of 1,800 feet in the clear. The work of erecting is being conducted from the shore ends without the use of any false work, one side being first extended 900 feet out from its tower, where it will remain perhaps more than a year seemingly unsupported until the other side is brought out to meet it.

Two steel travellers of large dimensions are doing the work of placing the bridge members in place. Each traveller is equipped with two Lidgerwood electric hoists of the most powerful type ever made. One traveller rests upon the bridge deck and extends over the end of the cantilever, being moved forward as fast as the parts it handles are put in place.

The other traveller is the more interesting. It is suspended between the bridge deck, with its upright



Electric Lidgerwood Hoists, Used in the Construction of the Bridge of the Quebec Bridge & Railway Company Across the St. Lawrence River, Near Quebec.

parts rising more than 300 feet high above the ground so as to pass on either side and above the tops of the towers of the bridge, each of which is 300 feet high.

The accompanying illustration shows the deck of this traveller and the two electric hoists with which it is equipped. Each of these hoists has drums 40 inches in diameter and 50 inches on the face and is capable of lifting 20,000 pounds on a single line. They have handled single bridge parts weighing 110 tons. The hoists are equipped with direct current motors of 150 horse-power each and are operated with 220 volts.

Besides the four big hoists for the travellers there are a dozen or more smaller electric hoists used in connection with the work.

NEW WESTERN BRANCH.

The Sunbeam Incandescent Lamp Company of Canada have established a branch office at 251 Notre Dame street, Winnipeg, where they will carry in stock a full line of their well-known lamps to supply their Western trade.

POINTERS FOR CENTRAL STATION MANAGERS

Stickers on Bills.

Several electric lighting companies throughout the country are working a very effective plan in connection with their monthly statements to customers.

Each time bills are sent out a small sticker is prepared, drawing attention to some particular point which the company thinks it well to emphasize to the public.

These stickers are attached to the bills when they are sent out and prove to be a very clever supplementary means of getting new business.

One month it will be a sticker drawing attention to electric fans and the various uses to which they may be put.

The next month electric irons will be emphasized.

The next month chafing dishes, etc.

This works out very cleverly, as customers who are using current only for light read these notices when bills are received and cannot fail to become interested, sooner or later, in some of the other propositions which the company has to offer.

Complaints.

Some trifling complaint from an illogical woman seems like "small potatoes" to the central station man with a big plant on his mind to bother him every minute.

But it's awfully important that such complaints are tactfully handled.

If your clerks have got into the habit of snubbing customers who have grievances it will, sooner or later, react to your disadvantage.

Remember the big, foolish public is foolish—but it's also big.

It may be tiresome to dish up a hundred times a week the same old explanations, the same old arguments, but—it's important—it's necessary that this should be done courteously, tactfully, and patiently.

You can't lose any business by treating customers well.

There is a tendency on the part of some central station managers who have no particular competition to cope with, to feel that they are at liberty to maintain a somewhat independent (and sometimes arrogant) attitude towards the public at large.

But—it doesn't pay in the long run. There is ever the great to-morrow.

One of the unsolved mysteries of this world lies in the fact that the public seem to expect that its relations (social or business) with electric central stations will be anything other than of a seraphic nature.

And—the exception only proves the rule.

Why this is, is beyond human ken to fathom.

Whose fault it is, doesn't matter much.

The remedy's the thing; and the public isn't likely to bother its head over the remedy.

So the cure lies with the central station, if cure is to be had.—"The Booster."

The Southwestern Traction Company have practically completed their road from London to Port Stanley.

Steps have been taken to establish a municipal telephone system in the municipality of Whitewater, Man.

EXPERIMENTS WITH CONCRETE TELEGRAPH POLES.

In a paper under the above title read before the convention of the Association of Railway Telegraph Superintendents, at Atlantic City, June 19-20, Mr. G. A. Cellar, superintendent of telegraph of the Pennsylvania lines west of Pittsburg, gave an account of some investigations made into the subject of preservatives for telegraph poles. The treatment of the entire pole was too expensive in proportion to the benefit thus derived, so it was decided to apply the preservative only to that portion of the pole extending 1 1-2 to 2 feet on either side of the ground and air line. That the result justified the expense is borne out by the present condition of the poles so treated. Mr. Henry Grinnell, Assistant Forest Inspector of the Department of Agriculture, in a report of experiments of this character, concludes that the application of preservatives to poles by means of brushes is so cheap that the cost is balanced by an increase of eight months in the life of the pole. As to steel poles, they are no more durable than the long-lived woods unless properly protected by preservatives. The inside as well as the outside of a steel pole open to the air should be accessible for the purpose of inspection and re-application of preservatives. In the author's experience, the preservation of steel imbedded in properly constructed concrete is perfect, and a telegraph pole made of reinforced concrete has a life that is practically unlimited.

Mr. Cellar then gave the results of experiments made by the Pennsylvannia lines west of Pittsburg with concrete poles. These results, however, are not presented as final, but rather more in the nature of a report on progress. Two hollow poles were made and tested, the object of this form of construction being to secure requisite strength with the minimum weight. One of the patterns was square in section, with the corners chamfered off; the other, octagonal in section, and the hollow space extending from the base for about two-thirds of the length of the pole, the upper third being solid, and the walls of the lower two-thirds being from 1 3-4 inches to 3 inches thick. These poles weighed approximately 3,500 pounds, and were calculated to withstand any stress in any direction that could possibly be imposed upon them by a line of 50 wires, each wire coated with sufficient ice to make it 1 inch in diameter. The tests were made in connection with two carefully-selected cedar poles of the same length (30 feet), and all were set in concrete, the bases being 3 feet by 3 feet by 5 feet deep.

Just within the outer surface, the walls of the concrete poles were reinforced with iron rods, which consisted of four 3-4 inch round bars, each 24 feet long, and four 5-8 inch round bars of the same length. The poles were 8 inches in diameter at the top and 13 inches at the base, having a taper of 1 inch in 5 feet. Galvanized iron steps were screwed into wooden blocks moulded into the concrete and holes were left for through bolts for supporting the cross arms. The cross arm braces were attached to the arms by through bolts in the same manner and fastened to the poles with ordinary lag bolts driven into wooden plugs which were placed in the concrete at the proper places. After standing long enough to permit the cement to become solid, the four poles were tested in turn for ultimate deflection. The results of the tests are as follows:

Octagonal concrete pole, 3,030 pounds pull at top, 11 3-4 inches deflection at top, cracked in two places.

Octagonal concrete pole, 3,430 pounds pull at top, 14 1-4 inches deflection at top, two other cracks.

Octagonal concrete pole, 3,210 pounds pull at top, 18 inches deflection at top, one more crack.

Octagonal concrete pole, 3,150 pounds pull at top, 25 1-2 inches deflection at top, broke at ground level.

Square concrete pole, 3,430 pounds pull at top, 34 1-2 inches deflection at top, one crack.

Square concrete pole, 3,690 pounds pull at top, 39 inches deflection at top, three more cracks—pole crushed crack at ground level.

White cedar No. 1 pole, 2,530 pounds pull at top, 47 inches deflection at top, pole broke.

White cedar No. 2 pole, 2,870 pounds pull at top, 35 inches deffection at top, one crack.

White cedar No. 2 pole, 3,494 pounds pull at top, 66 inches deflection at top, pole broke.

After the cement poles had been broken, the reinforcement so held them that it required almost the breaking pressure to further deflect them from their slightly inclined position. The wooden poles under strain presented the form of an arch before breaking, and when they gave way were fractured completely; but these features were lacking in the cement poles, which were very firm and did not give until they began to crush at the ground line.

The argument has been advanced that the reinforced cement pole would be very liable to damage or disruption by shock, but the fact that concrete piles, both of hollow and solid designs, are driven by pile-drivers, and especially with the knowledge of the experiments at Rochester, which showed that the poles, even after they had been fractured at the surface of the foundations, required an extremely heavy pressure to produce further deflection from the positions at the time of fractures—in other words, that they were almost as stiff as when they stood upright, and continued to be so throughout the entire test—the author felt that any alarm at the prospect of damage by collision between the pole and anything less than a movable object that would destroy any pole of natural or manufactured composition is unfounded.

As to the insulating qualities of the concrete pole, the author stated that they were superior to those of any other pole manufactured in this country.

Continuing experiments already made, the company will soon set some steel poles, with just enough concrete to serve as a preservative, and other steel poles covered with a cement paint. The concrete poles used in the above tests were made and tested in the yards of Robert A. Cummings, at Rochester, Pa.

In spite of many difficulties, the Stave Lake Power Company are making good progress with their power development works on the Stave River, near New Westminster, B.C. About 200 men are now employed, and it is expected that they will be ready to deliver power within a year.

Gas generated in a producer, without the use of steam, has a thermal value of about 70 British thermal units per cubic foot. By using steam with the air admitted to the fire, the producer gas generated will immediately have a thermal value of from 135 to 140 British thermal units per cubic foot.

USE OF WATER POWER.

In the Equity Court at Bathurst, N.B., on July 22nd, before Judge Barker, the case of Alderman C. Brown versus the Bathurst Electric & Water Power Company was opened. The points in dispute are of considerable interest to mill owners using water power on the rivers of the province, as the plaintiff claims that by the establishment of an electric lighting plant run by turbines some distance above his mill, he is to a great extent deprived of water and unable to continue his business. The plaintiff owns a grist mill and a carding mill on the Tetagouche River, which have been in operation for forty years. In his claim he contends that the defendant company constructed a dam across the river in 1904 and started to operate machinery at a point nearer his mill than was provided for in the act of incorporation, and that the plans have never been approved by the Lieutenant-Governor-in-Council. He alleges that the gates connected with the dam are kept shut for long spaces of time and that he has been injured in his business by want of water. The machinery is only run at night and the plaintiff claims that the sluice is always closed in the day time to enable the water to be stored to operate the turbines.

There is also a complaint that while the Tetagouche was formerly a salmon river the defendants have neglected to provide a fish way, and that the value of the plaintiff's salmon pool is destroyed. On these various counts the court is asked to award damages and restrain the defendants from operating the dam.

The defendant company deny that they store the water by their dam to the injury of the plaintiff, or that they are making an unreasonable use of the stream.

Mr. George Leighton, of Harriston, Ont., is offering his saw mill and electric light plant for sale.

Mr. John S. Fielding, C.E., of Toronto, has prepared plans for a power development at Middle Falls, on the Trent River, for the Town of Campbellford, Ont. Tenders for rock-cutting, concrete work, turbines, generators and about two and one-quarter miles of transmission line will be received by the Mayor of the town up to August 15th.

The Bell Telephone Company have purchased property at the corner of St. Joseph boulevard and Cadieux street, Montreal, on which they will build a large new north end exchange, at an approximate cost of $250,000.

SPARKS.

The Bell Telephone Company have practically completed the installation of a new switchboard in their exchange at Calgary, Alta.

The ratepayers of Chatham, Ont., will shortly vote on a by-law to raise $15,000 for the extension of the electric light plant.

The name of the Maple Leaf Automobile & Electrical Manufacturing Company has been changed to the Galt Electrical Manufacturing Company, Limited.

Mr. John Davidson has purchased the electric plant at Millbrook, Ont. He has secured exemption from taxation and the contract of lighting the town at $700 per year.

The Stark Electrical Systems, Limited, of Toronto, have commenced work on their new lightning contract at St. Catharines, Ont. The power will be obtained from the Ontario Power Company.

It is announced that the Western Counties Electric Company will erect a new building in Brantford, to contain the offices of the company and a sub-station for transforming the current from DeCew Falls.

The City of Winnipeg recently accepted the following tenders for the supply of arc lighting apparatus: Canadian General Electric Company, for three 50 light C. C. transformers and panels; also twelve lightning arresters, at $2,810, Packard Electric Company, for 100 arc lamps and cut-outs, at $2,700.

The Civic Electric Commission of Ottawa have purchased a 750 horse-power generator to be installed at the waterworks as a temporary source of supply to the municipal electric plant. The purchase was made from Rossiter, McGovern & Company, of New York.

The American Street Lamp & Supply Company, a corporation incorporated under the laws of the State of Delaware, has been authorized to carry on business in the province of Ontario, with a capital of $40,000. Mr. S. C. Smoke, of Toronto, has been appointed attorney.

The Fire, Light and Power Committee of the City of Regina have reduced the price of electric light from 12 cents per kw. hour to 9 cents for all accounts up to $100 per month, and 8 cents for all accounts over that amount.

The annual meeting of the shareholders of the Canadian Electric Light Company took place at Quebec last month. The net profits for the past year were shown to have been $21,091.24, while in addition $3,402.64 was spent for betterments, and $1,197.59 was appropriated to depreciation on transformers, meters and instruments. The amount earned on the common stock was about 10 per cent. Directors were elected as follows: President, Hon. L. P. Pelletier; vice-presidents, Messrs. Rod, Audette and H. M. Price; directors, Messrs. Chas. King, W. A. Marsh, Etienne Dussault, Jos. Gosselin, Geo. Demers and John Ritchie.

SPARKS.

One of the signs of western progress is the building of the new abattoir at Vancouver of P. Burns & Company. This is said to be the finest abattoir on the Pacific coast, and is up-to-date in every respect. It is operated entirely by electricity upon individual drive principles. There is installed at present two 30 horse-power, two 10 horse-power and two 5 horse-power 900 revolutions per minute induction motors of the Allis-Chalmers-Bullock manufacture, and it is anticipated that this installation will be shortly increased.

The Sydney & Glace Bay Railway Company, operating the interurban railway between Sydney and Glace Bay and around the various colliery towns of the Dominion Coal Company, have decided to locate their central power station and car barns in Glace Bay.

The Canadian Pacific Sulphite Paper Company propose constructing pulp and paper mills at Swanson Bay, B.C. The contract for the excavation and concrete work on the pulp mill has been given to the British Columbia General Contract Company, of Vancouver, and that for the power dam, pipe line and electric plant to Elliott & McCallum, also of Vancouver. The dam will furnish a head of 120 feet of water, and for the initial installation there will be three Pelton waterwheels.

The announcement is made that work on the new electric railway from New Westminster to Eburne, is to be commenced immediately, the contract having been awarded to Mr. J. B. Bright. This road is being built by the Canadian Pacific Railway for the use of the British Columbia Electric Railway Company, and will run for nearly ten miles along the banks of the north arm and within a short distance of the river road.

The Hydro-Electric Power Commission have sent out a fourth surveying party, which will take up the work of locating the transmission line from Hamilton to Guelph, Berlin, St. Mary's and Stratford. The survey of the line to Woodstock has been completed.

The town of Morden, Man., is to have a municipal electric plant. The Robb Engineering Company, of Amherst, N.S., will supply the steam plant at $4,216, and Allis-Chalmers-Bullock, Limited, of Montreal, the electrical plant at $9,125.

As evidence of our growing trade with the Orient, we would cite the recent starting of the Vancouver Milling & Grain Company's new elevator and flour mill. This flour mill is up-to-date in every respect and the entire outfit is operated by electricity, the motor power being obtained from a 100 horse-power and 50 horse-power Allis-Chalmers-Bullock induction motor.

The Northumberland & Durham Power Company are considering the question of transmitting power to Kingston. The point of development will be Healey Falls. Messrs. Connor, Clarke & Monds, consulting engineers, of Toronto, are making a report on tho project. The managing director of the Northumberland & Durham Power Company is Mr. J. A. Culverwell.

The electric plant at Moose Jaw, Sask., is at present equipped with three boilers having a total capacity of 450 horse-power. These have been found inadequate, and the question of installing additional boiler capacity is now under consideration.

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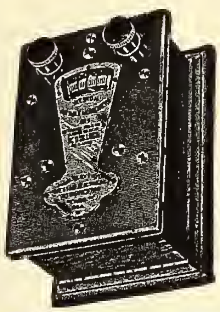
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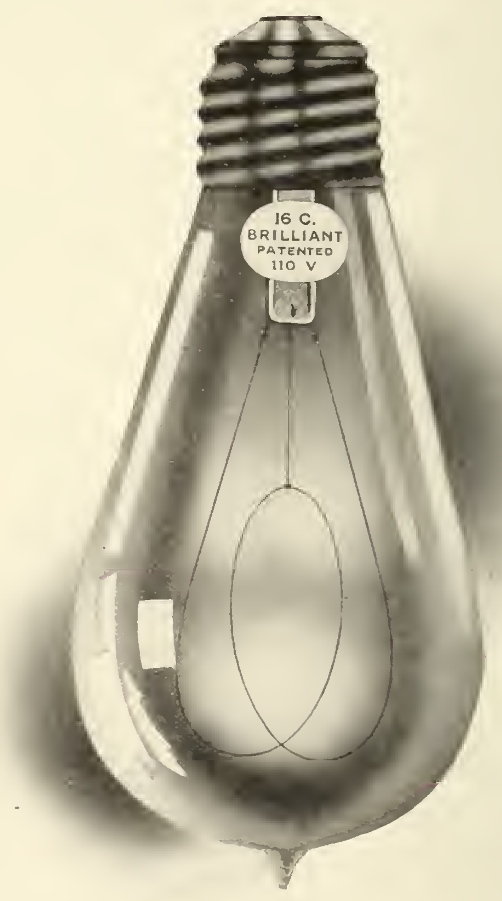

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SEVENTEENTH YEAR. No. 9. | TORONTO, MONTREAL — SEPTEMBER, 1907 — WINNIPEG, VANCOUVER | PRICE 10 CENTS $1.00 PER YEAR.

SAFETY DEVICE FOR ELECTRIC RAILWAYS.

Mr. James D. Shipton, electrician, of Vancouver, received last week a Canadian patent on an improved safety device for the protection of a single-line section of an electric railway.

This invention is particularly designed for the protection of single-line sections of an electric railway where it crosses a bridge or high trestle, but the device may be susceptible of application for the protection of any single-line section where it is unsafe to allow more than one car to run at a time. The safety afforded by Shipton's device is absolute, as a protecting section of line from the trolley wire of which the current is automatically cut off is preserved at each end of the section it is desired to protect until the car which occupies the protected section has passed off it.

It also comprises means whereby if one car attempts to trail behind another and thus evade the safety requirement the current is cut off entirely from the section occupied by the cars until the conditions of safety are restored.

The appliance is not an expensive one to install or maintain and should commend itself to electric railway companies or to municipal authorities for the proper safeguarding of the public.

A syndicate is being formed for the exploitation of the invention.

MOONLIGHT SCHEDULE FOR OCTOBER

Date.	Light.	Date.	Extinguish.	No. of Hours.
Oct. 1	6 10	Oct. 2	2 20	8 10
2	6 10	3	3 20	9 10
3	6 10	4	4 20	10 10
4	6 00	5	5 20	11 10
5	6 00	6	5 20	11 20
6	6 00	7	5 20	11 20
7	6 00	8	5 20	11 20
8	6 00	9	5 20	11 20
9	6 00	10	5 20	11 20
10	6 00	11	5 30	11 30
11	6 00	12	5 30	11 30
12	5 50	13	5 30	11 40
13	5 50	14	5 30	11 40
14	10 00	15	5 30	7 30
15	11 00	16	5 30	6 30
17	0 15	17	5 30	5 15
18	1 20	18	5 30	4 10
19	2 30	19	5 40	3 10
20	3 40	20	5 40	2 00
21	No Light	21	No Light	
22	5 40	22	7 50	2 10
23	5 40	23	8 20	2 40
24	5 40	24	9 00	3 20
25	5 30	25	9 40	4 10
26	5 30	26	10 30	5 00
27	5 30	27	11 20	5 50
28	5 30	29	0 10	6 40
29	5 30	30	1 10	7 40
30	5 30	31	2 10	8 40
31	5 30	Nov. 1	3 10	9 40
			Total...........	226 05

The Toronto, St. Catharines & Niagara Railway have secured options for the right-of-way from Welland to Port Colborne. It is probable the line will be built next year. Cars will be running between Welland and St. Catharines this month.

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SPARKS.

The official tests on the new eight hundred kilowatt plant at Morrisburg, Ont., were made recently by Mr. Willis Chipman, C. E., and Mr. K. L. Aitken, C. E., both of Toronto.

A patent granted July 9 to Messrs. E. W. Mix and Paul Binet, of Paris, describes a method of balancing the field excitation of multipolar dynamos with parallel wound drums. This consists in the case of a four-pole machine, of providing two windings on each pole, one of which is connected with one pair of brushes and the other with the second pair.

At a meeting of the Stratford Gas and Electric Company, held August 15th, Mr. W. C. Kennedy, of Windsor, was elected president, to succeed the late Dr. King, of Kingsville. Mr. J. P. King, of Stratford, was made secretary-treasurer; J. C. Baxter, Detroit, managing director; Messrs. Jas. O'Loane, Stratford, and C. S. King, Windsor, directors.

ILLUMINATING NIAGARA FALLS.

Messrs. Ryan and Stickney, illuminating experts for the General Electric Company, left Niagara Falls on August 19th for Lynn, Mass. to perfect arrangements for the installation of the gigantic scintillator below the Horseshoe Falls for the illumination of the cataract. Nothing so stupendous, spectacular and at the same time so majestic in dignity has ever been attempted in the United States, and when the lights are turned on the falls for the first time on the night of September 2nd, an important era in the system of decorative lighting will have been established.

The English army and Uncle Sam's warriors have thirty inch searchlights for use in signalling, and records show that the powerful rays from these lights are visible for a distance of more than 100 miles. There are several of these powerful lights included in the scintillator. But besides the thirty inch projectors are five sixty inch projectors, the biggest ever manufactured. Turned heavenward, the lights will be plainly visible in Buffalo and Toronto, and when flashed into the face of the cataract, the rocks behind the mighty fall of water will be revealed to the eye. However, the operation of the scintillator will be of a nature to preclude the prevalence of anything boldly spectacular or conspicuous. There will be a harmorious blending of color, rendering the effulgence of light luminescent and awful in grandeur. Turned onto the rebellious burst of spray, the lights will produce an effect which for splendor promises to defy description.

Colors of every imanginable hue and tint will be employed to vary and enhance the brilliancy. From delicate orange and violet to the sharper colors, there will be no omission.

The machines will be brought to Niagara Falls on three freight cars. The illumination will continue for at least a month, and probably longer.

INCREASED CAPITAL FOR THE CANADIAN GENERAL ELECTRIC COMPANY.

At a special meeting of the shareholders of the Canadian General Electric Company, held in Toronto August 15th, the capital of the company was increased from $5,000,000 to $8,000,000.

Mr. Frederic Nicholls, second vice-president and general manager, stated that the company had had an uninterrupted share of prosperity, and the last annual report contained every balance sheet of the corporation for the past 16 years. At present the company had $5,000,000 worth of work on hand, and $5,000,000 in liquid assets. The directors wanted to apply for letters patent to increase this stock and they could finance it in several ways. The company might stop taking orders for a time, and its $5,000,000 liquid assets would thus be worked up. He thought it would be wiser to increase the capital than to give business to the competitors of the company. The profits last year were over $800,000, and this year it seemed that they would be equally good or better. With profits of $853,000, the company was left $713,000, after the payment of preferred dividends.

LIGHTING TRANSFORMERS

This is a view of one of our 10 k. w. Lighting Transformers. Bulletin 300 describes our full line of Lighting Transformers. Among the good points are:

1. LOW CORE LOSS
2. HIGH EFFICIENCIES AT ALL LOADS
3. LOW TEMPERATURE RISE
4. GOOD REGULATION
5. STRONG MECHANICAL DESIGN

ALLIS-CHALMERS-BULLOCK

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"Allis-Chalmers" Mining, Sawmill and Flour Mill Machinery, Engines, Pumps and Turbines; "Bullock" Electrical Apparatus; "Lidgerwood" Hoisting Engines; "Inge soll" Air Compressors, Rock Drills and Coal Cutters.

Head Office and Works: MONTREAL

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TORONTO—810 Traders Bank Building.
WINNIPEG—251 Notre Dame Avenue.
NELSON—Josephine Street
MONTREAL—82 Sovereign Bank Building.
NEW GLASGOW, N. S.—Telephone Bldg.
VANCOUVER—416 Seymour Street.

BIG PRODUCER GAS PLANT.

There has been erected at the works of the Simonds Canada Saw Company, Limited, St. Remi, Montreal, the largest industrial producer gas plant in Canada. This plant is of 600 B.H.P. capacity, and is to be used both for driving gas engines and providing gas for the various furnaces in the works. For almost a year Messrs. Simonds have had a 50 B.H.P. suction gas producer and engine operating part of their plant, and the great saving effected by its use has gone far in inducing them to put in the present installation. The new plant consists of two independent producer units of 300 B.H.P. each, both having independent cooling and scrubbing apparatus, but discharging into one large gas-holder of the gas works type.

After leaving the producers, which are of the Dowson type, the gas is first thoroughly cooled in a series of horizontal cast iron coolers, which have an exceptional radiating surface; it is then passed through a double water-sealed box of special design, from thence through coke scrubbers of large capacity, and finally through dry purifiers, the gas in this manner being thoroughly cleaned of all tar, dust, and other impurities.

The first of the large engines to be erected was a four cycle single cylinder horizontal unit of 150 B.H.P.

This engine is what is classed by English builders as "special electric light type," having extended crank shaft with outer bearing, and only one flywheel of extra large diameter, and weighing ten tons. The crank shaft bearings are of the continuous oiling type, similar bearings being also provided for the secondary shaft. The cylinder is provided with a removable liner, and all the valves are seated into loose boxes, the exhaust valve is fitted with the latest type of relief gear. A great feature of the engine is its water cooling arrangements; independent water cooling is provided for the cylinder, piston, cylinder head, exhaust valve, and exhaust valve seat; in this manner premature ignition due to overheating of the parts named is eliminated. Ignition is effected by a powerful magnetic machine.

The operator is provided with means of independently controlling the amount of air or gas, the time and intensity of the spark, and the engine speed. The engine is started quietly and easily by means of compressed air, one man only being required.

When completed, the Simonds Canada Saw Company will have a plant to be proud of, and they are to be congratulated on their enterprise in thus setting forth in so practical a manner their faith in the future of producer gas.

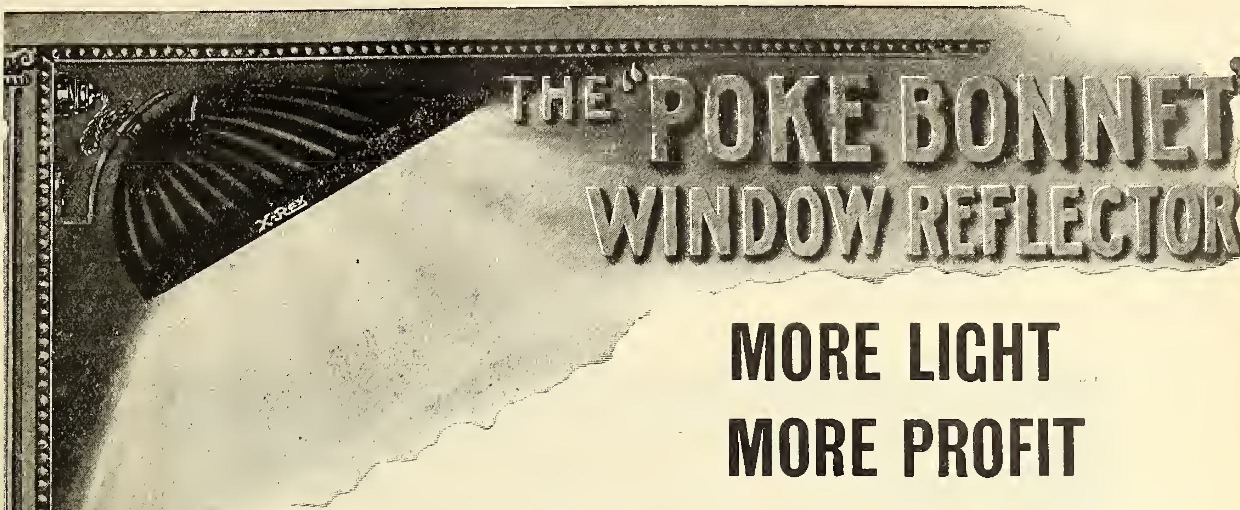
The whole of the above mentioned plant is being supplied by the Producer Gas Company, of 11 Front street east, Toronto, of which Mr. G. P. Wallington is the manager.

The erection of the plant was in the hands of S. G. Doyle, engineer to the Producer Gas Company, and the building of the producer house, furnaces, foundations, etc., was done by J. C. Miller, Messrs. Simonds' engineering superintendent.

The plant supplied is of British manufacture, but in future the producer plants will be of Canadian manufacture, built to the Producer Gas Company's own designs.

It is currently reported that one result of Vice-President McNichol's visit to Medicine Hat, Alberta, will be the establishment of an electric power plant to operate the C. P. R. works.

Edmonton, Alberta, is in need of additional electric power, and it is proposed to utilize the engine in Walters' saw mill, where a 150 kw. alternator will be installed. If this is not sufficient, electric power may be transmitted to Edmonton from Strathcona.



MORE LIGHT MORE PROFIT

If you can show any merchant how he can obtain more light at less expense, thereby not only saving money, but giving him opportunity to make more—then you can make more profit yourself.

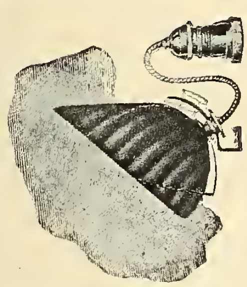
X-RAY REFLECTORS are helping many dealers to greater profits. They're popular and becoming more so. We sold over 35,000 "Poke Bonnets" alone since February of last year, and the demand still increases.

EVERY X-RAY REFLECTOR is plated with pure sterling silver, which is well-known as the greatest reflecting surface known to science.

This plating is done in such a manner that it will never peel, crack, cloud, blister or tarnish.

EACH REFLECTOR is built on scientific principles and planned for some special purpose.

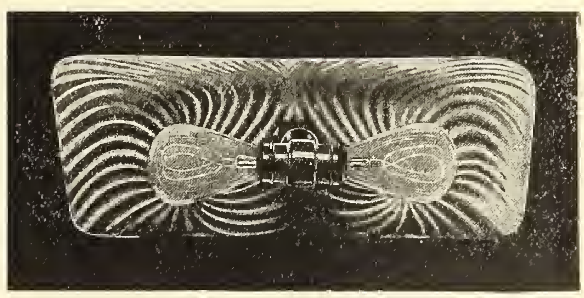
The corrugations are not designed in a haphazard style, but are the result of careful experimenting.



Trough Supported from Wall or Transom Bar

TAKE THE "POKE BONNET"

as a sample. It is only fourteen inches long. In the ordinary window, three or four reflectors, using six to eight lamps, will produce as much light and of a better quality than the old fashioned trough reflectors using twelve lamps.

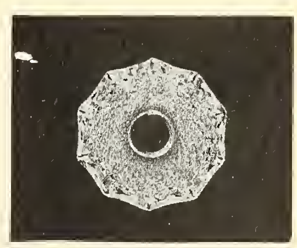


Poke Bonnet, interior view, showing spiral corrugations, twin socket and two lamps.

This shows a big saving in expense for current, of if a merchant will use an additional reflector, his light will be greatly increased and he will still save money.

No. 660. Ceiling Reflector with Cluster. Great for ceilings, assembly halls, etc.

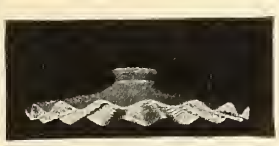
OUR OTHER REFLECTORS, designed for special purposes, are equally efficient. The cuts on this page show only a few of them. Our catalogue shows others.



No. 6107, interior view. For ornamental purposes, fancy fixtures, etc.

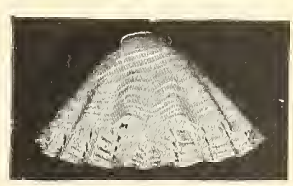
X-Ray Reflectors show the greatest advance that has been made in reflecting artificial light in the last twenty-five years.

You can make instant deliveries, as there is no waiting for "made to order." You can carry the goods right in stock. Your profit is sure from the beginning. We furnish you with convincing literature.



No. 695. 8 and 10 inches. For use with single incandescent.

Write us for full information and prices.



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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XVII. SEPTEMBER, 1907 No. 9.

THE HYDRO-ELECTRIC PLANT AT KAKABEKA FALLS, ONT.

Before beginning the construction of this plant, a careful investigation was made of the variations of the flow of the Kaministiquia river, and of the other features which would affect the reliability of the service obtainable from same, and a general plan was then adopted for the development of the power at Kakabeka Falls, with an initial installation of 14,000 horse-power, plans being made and the greater portion of the work carried out on the basis of continuing the initial installation to an ultimate development of 40,000 horse-power.

Kakabeka Falls is situated on the Kaministiquia river about twenty miles from Fort William, on the Canadian Northern Railroad. The falls are among the most beautiful in Canada, with a large volume of water having a shear drop of approximately one hundred and twenty feet. The water is diverted from the Kaministiquia river at a point about a mile above the falls, in order to take advantage of the additional head afforded by the Ecarté rapids. At this point it was necessary to make a heavy rock cut to divert the river in order to construct the sluice dam and intake. The power is transmitted to Fort William at a pressure of 25,000 volts.

All water rights and the necessary land abutting on the river, from the point of diversion to a point of return, were secured, as well as all land necessary for flumes and other structures.

To facilitate construction, a siding and temporary station was built on the line of the Canadian Northern Railway, and located about one-half a mile from the Falls. A narrow gauge railway was constructed for delivering the supplies to the head works and power house and for distributing the material along the pipe line.

Kaministiquia Power Company—View of Kakabeka Falls, with Full Volume of Water.

Source of Supply.

The Kaministiquia river has its source in Dog Lake, situated about 50 miles north of Kakabeka Falls. There are a number of rivers emptying into the Kaministiquia; the principal source, however, is Dog Lake, which covers an area of 51 1-2 square miles.

The lake is surrounded by heavy timber land and a large amount of muskeg. The timber retains the snow until well into the summer months, and the muskeg retains the water until the lake falls sufficiently to draw on this source of supply.

The Power Company has the right to raise the lake 10 feet and lower the lake 3 feet, thereby allowing a

storage of 13 feet, which, if required, would give a storage capacity that would take care of the dry season, and, if necessary, give a constant supply equal to 60,000 horse-power.

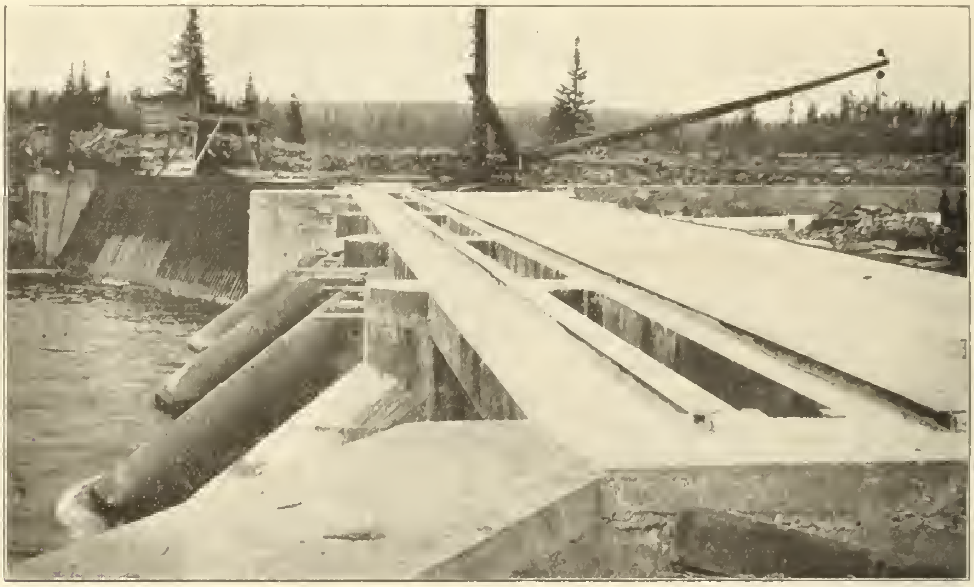
Dam and Intake.

About a mile above Kakabeka Falls, on the Kaministiquia river, is located the dam and intake of the Kaministiquia Power Company. Here the water necessary for the operation of its plant is diverted by solidly constructed dams through a concrete intake to flumes, which are constructed on the south side of the river, and extend to the forebay, a distance of 6,500 feet. The main dam is about 300 feet long and 15 feet high, built of concrete on the bed of the river, which is solid rock. The dam is constructed of concrete piers four feet wide by 25 feet in length. These piers carry a bridge, and the mechanism for raising and lowering stop logs set in checks in the piers.

The intake is set at almost right angles to the dam and is so constructed that ice and debris cannot readily enter the intake. The intake, or entrance canal, is about 125 feet long, at the end of which is located a spillway for discharging any ice or debris that may possibly pass the first set of racks adjoining the spillway, at the small racks protecting the entrance to the concrete flumes.

Concrete Flume.

From the head works to the reservoir, a distance of about 6,500 feet, the water is carried in a concrete pipe, 10 feet 2 inches inside diameter, reinforced with steel rods, forming a 6 inch mesh. This flume is built partly on top of the natural ground and for part of the distance is set below the level of the original ground line. The pipe is not level, but in a measure follows the profile of the original ground line. The maximum pressure on the pipe, at full head, is 12 pounds.



Kaministiquia Power Company—Main Dam.

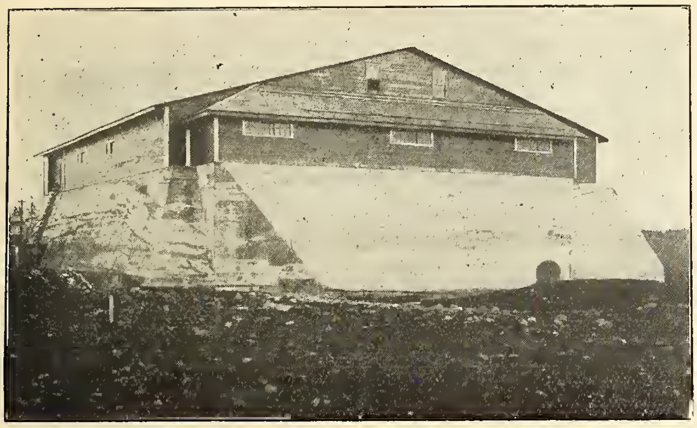
Kaministiquia Power Company—Concrete Flume.

A soon as the concrete pipe was constructed, and time allowed for the concrete to set, the pipe was covered to a depth of 2 feet. Drain valves, air vents, etc., are provided at various points along the pipe line, and provision made for lighting and heating the vents, drains, etc., in an emergency and in cold weather.

The wooden forms were made in bolted sections, shifted and used again as fast as the hardening of the concrete would permit. The concrete was brushed inside and out, and a coating of tar and rosin applied to the inside.

Forebay.

The concrete pipe just described discharges its water into a forebay, located on a high plateau about 165 feet above the power house floor. This forebay serves as a relay to maintain the plant in continuous operation, to take care of fluctuating demands of the water supply, and is also used to take care of the excess water that would accumulate in the event of a sudden shut-down in the power house.



Kaministiquia Power Company—Forebay.

The forebay is a massive structure built of concrete and covered in to protect employes and mechanism from the weather. It is provided with stop logs and gates on the penstock side, and stop logs on the aqueduct side, also a syphon spillway, to prevent freezing in severe winter weather.

Penstocks.

The penstocks, one for each of the two generator units now installed, connect the forebay with the waterwheels in the power house. Each penstock is 800 feet in length, made of riveted steel, 7 feet 6 inches diameter, 1-4 inch thick at the upper end, and tapering to 9-16 inch at the power house. They are anchored by massive concrete abutments and housed in the entire distance between the power house and the forebay. They approach the power house on a long curve, expansion and contraction being thus taken care of. The exciter penstocks are tapped into the main penstocks at present, but provisions have been made for a separate penstock from power house to forebay. The penstocks were constructed by the Jenckes Machine Company, of Sherbrooke, Que.

Power House.

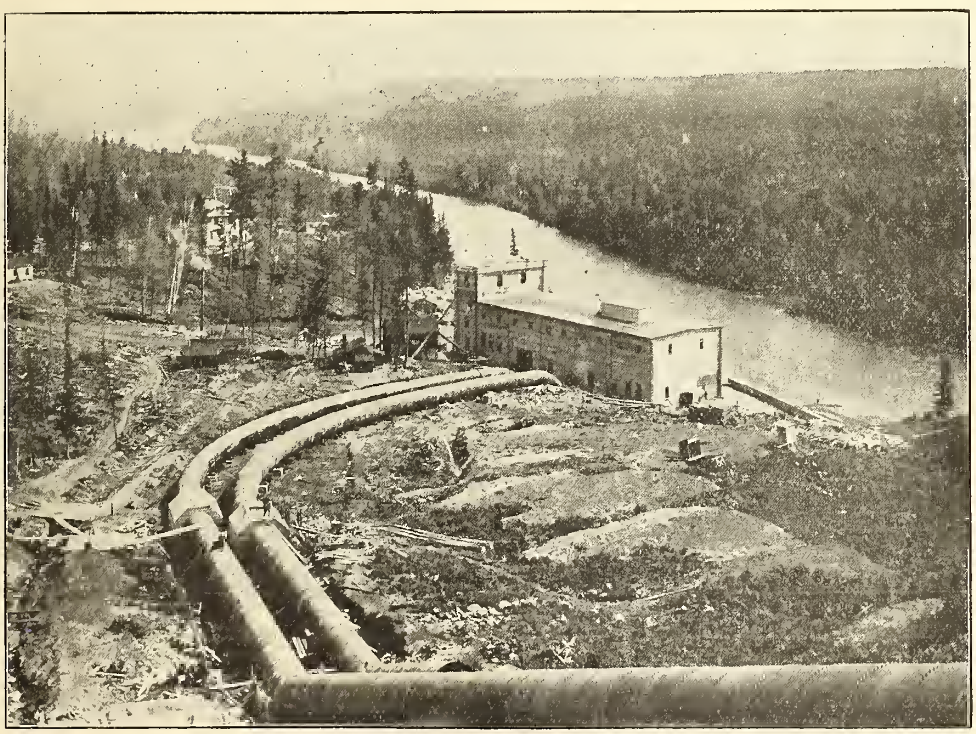
The power house is a massive concrete and steel structure, built on the bank of the river, on a foundation of rock. The building is complete for the entire development, with the exception of an extension of 100 feet for additional generators. This extension will consist of merely the two walls and roof to allow space for the additional generators. The steps, walls and partitions are built of either concrete or steel. The windows are fireproof construction, the frames and sashes being made of galvanized iron and glazed with wire glass.

Water Wheels.

Each unit consists of two horizontal turbines mounted on one shaft and direct connected to the generator. The turbines have a maximum capacity of 7,000 horse-power. They were furnished by J. M. Voith, of Heidenheim, Germany, and are described in detail elsewhere in this issue.

Generators and Exciters.

There are two revolving field generators, made by the Canadian General Electric Company, of 4,000 kw. capacity each, having an overload capacity of 25 per cent. They are wound for three phase 4,000 volts, and a frequency of 60 cycles per second.



Kaministiquia Power Company—Penstocks from Forebay, Looking Towards Power House.

Two 150 kw. 125 volt 600 revolutions per minute shunt wound exciters are provided, each direct connected to a Voith waterwheel. The wheels driving the exciters are equipped with automatic governors,

and the water can be supplied to the exciter water-wheels from either penstock. Each exciter is capable of exciting five generators under all conditions.

Transformers.

There are two banks of transformers installed in the power house, each bank consisting of three 1,500 kw. air cooled Canadian General Electric transformers with 25 per cent. overload capacity. They are located on a raised platform at one end of the power house, with the air chamber beneath them. There is room for three more banks in the present power house.

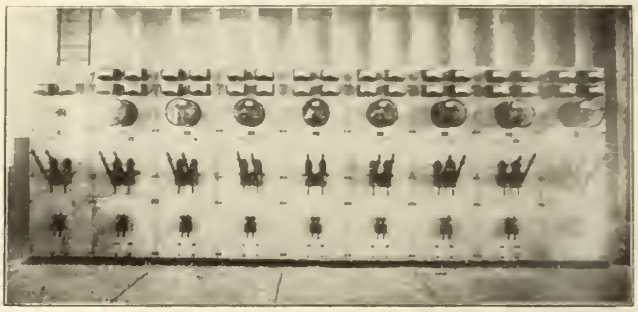
Electrical Arrangement.

The air pressure is maintained by two blower sets, each consisting of a 60 inch Buffalo steel blower, direct connected to a 7 1-2 horse-power induction motor. The current is conveyed from the generators through tile ducts laid in the concrete floor to a selector switch in front of the air chamber, one branch from the selector switch leading to the transformers and the other branch to the 4,000 volt bus bars through a solenoid operated oil switch.

The 4,000 volt bus bars are arranged so that the machines may be synchronized on the low tension bus bars, and also that either machine may be connected to either bank of transformers. The double set of high tension bus bars are located in concrete bus bar compartments, with a disconnecting switch and motor-operated oil switch between bus bars and transformers and between bus bars and lines. The bus bar switches and the lightning arresters are contained in a tower at one end of the power house.

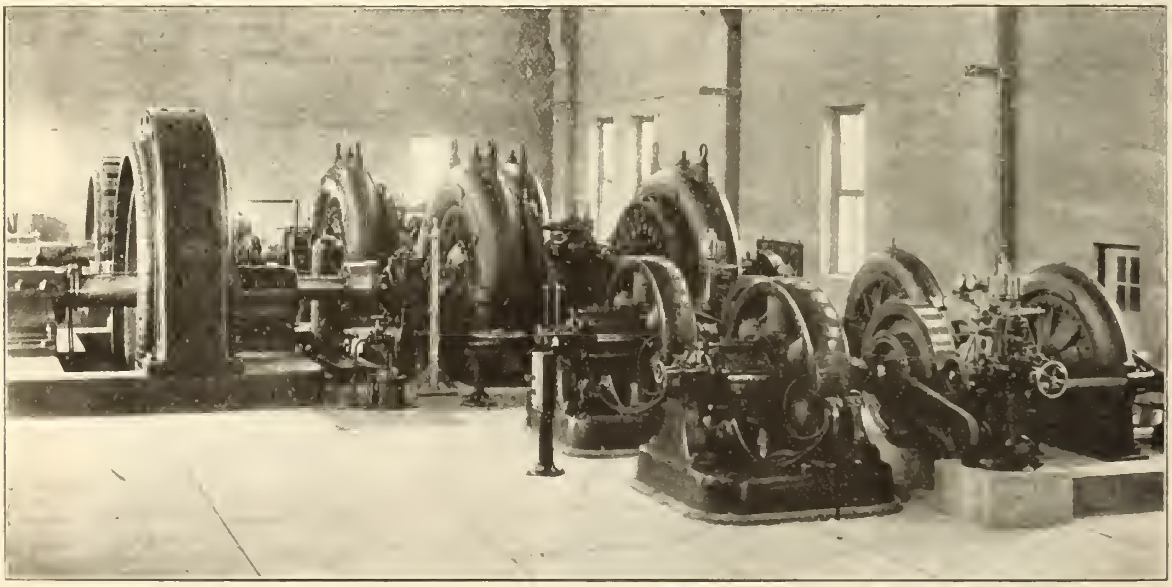
insulated cable carried in tile conduits laid in concrete slabs, all other high tension wiring being of bare copper supported in insulators fastened in the concrete by means of wood pins.

The cells for oil switches, bus bars and lightning arresters are all made of concrete. The switchboard is of the latest design and thoroughly up-to-date. The total length of the board is 22 feet, and consists of one two circuit line panel, two generator panels, two exciter panels, one station panel, and one blank panel for regulator to be installed later, three blank panels for additional generators, and one blank panel for two additional transmission lines.



Kaministiquia Power Company—Substation Switchboard.

The reducing transformers for the supply of light and power for the station are located outside of the building, and no E. M. F. higher than 125 volts is brought to the board. The exciter bus bars are in duplicate on the rear of the board, and the generator fields may be connected to either set through the several discharge resistance by means of a double throw switch.



Kaministiquia Power Company—Interior of Power House, Showing Generators.

The rheostats are motor-operated and are located in a chamber under the main switchboard floor. The power house is equipped with a 35 ton Niles crane, driven by three motors operated from the exciter bus bars.

The transformer switches are on the same floor and in the rear of the transformers. The high tension bus bars are on the second floor directly above the oil switches, the line switches on the third floor above the bus bars and the lightning arresters on the fourth floor. The high tension wires pass through circular holes in the concrete floors.

All secondary wiring from transformers and for control of oil switches is carried in galvaduct laid in the concrete floors and walls. The high tension wires leading from the transformers to the oil switches are

Transmission Lines.

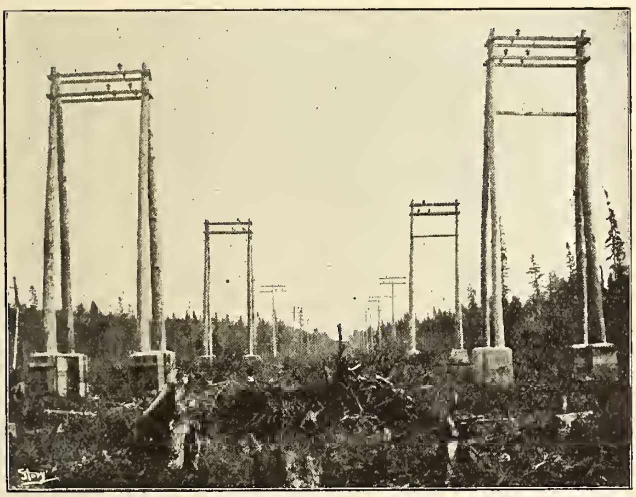
The transmission lines, two in number, leave the building through 15 inch tiles, at both ends of which are set heavy plate glass shields with a hole in the

centre, the entrance being further protected by a concrete hood on the outside. The transmission system consists of two lines of cedar poles set forty feet apart, 110 feet between individual poles.

The distance of transmision is about 18 1-2 miles, at a voltage of 25,000 volts between line and ground. The transmission wire is No. 00 copper, on Thomas insulators, the triangle being 30 inches.

One circuit is carried on each pole line, each circuit being on one side of the pole with cross arms arranged for an additional circuit when the capacity of the plant is increased.

The line passes through heavy muskeg swamps and great difficulty was experienced in the hauling of material and the setting of poles. Where the line crosses the tracks of the Canadian Pacific Railway and the Canadian Northern Railway it was necessary to erect a tower of four wooden poles set in concrete, the concrete being carried five feet above the ground level, to protect the poles from bush fires. A No. 00 stranded hemp core cable was used across all railroad right of ways. A No. 5 galvanized iron wire is run at the top of the pole, and at the ends of the upper cross arm, these wires being grounded every second pole.



Kaministiquia Power Company—Transmission Line.

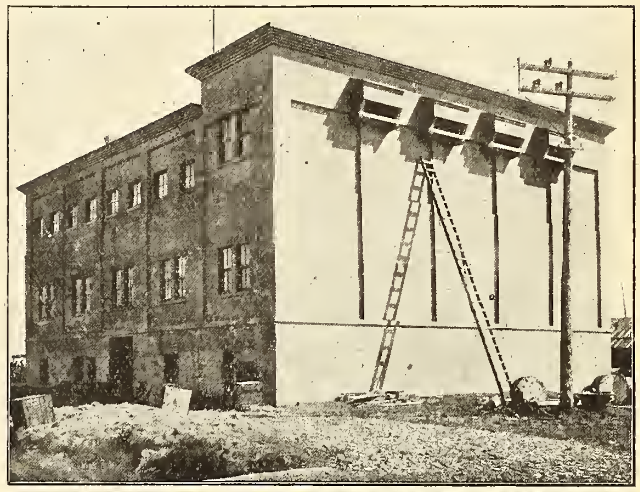
One line carries a telephone line of No. 9 galvanized iron wire, transposed every third pole, and supported on cross arms 5 feet below the main arm.

Sub-station at Fort William.

The sub-station at Fort William is a two storey concrete building, with galleries. The high tension line enters in a similar manner to its entrance at the power house. The low tension and high tension lightning arresters are situated on galleries on opposite sides of the building.

The high and low tension oil switches, transformers, switchboard, benchboard and motor generator set are located on the main floor, while the high and low tension bus bars, feeder switches, air chamber and battery room are located in the basement. The high tension bus bars are in duplicate, and are placed in concrete apartments similar to those at the power house. A small motor generator set and battery are furnished for operating the motor-operated oil switches. The station is equipped with a 15 ton hand operated Niles crane.

The switchboard consists of a station panel, motor generator panel and ten feeder panels of 1,000 kw. capacity each.



Kaministiquia Power Company—Substation at Fort William, High Tension End.

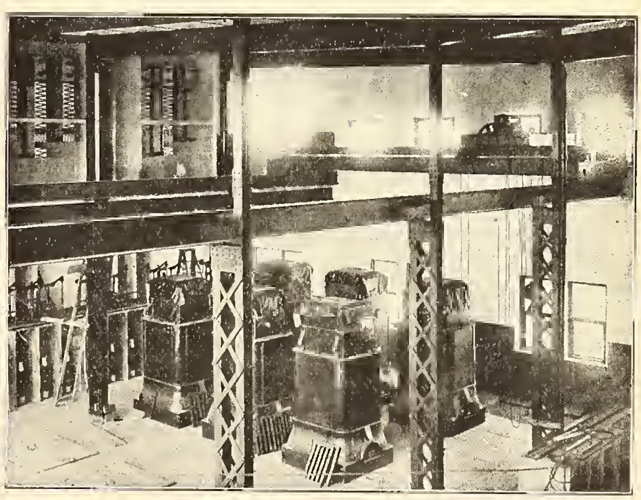
The station is built for the full output of the power plant, but only two banks of transformers are installed at present.

At the power house the transformer switches are provided with inverse time limit overload relays, operating to cut out the transformer bank on the high tension side. Out-going lines are provided with T. P. overload definite limit relays. At the sub-station the incoming lines are provided with T. P. overload inverse time limit relays, and the step-down transformers with T. P. instantaneous reverse current relays. The current is stepped down to 2,300 volts for local distribution throughout the town.

The consulting engineers for this important and interesting hydro-electric plant were Mr. William Kennedy for the hydraulic installation and Mr. R. S. Kelsch for the electrical equipment. The electrical apparatus was furnished by the Canadian General Electric Company and installed by Mr. A. E. Gregory under the supervision of Mr. W. R. Bonnycastle, electrical construction engineer.

Mr. R. W. Leonard was resident engineer, and Mr. R. T. Rogers superintendent of work at the power house, with Messrs. T. Byrne and A. J. Aldred as assistant engineers.

The management of the Kaministiquia Power Company, Limited, consists of Mr. W. A. Black, western



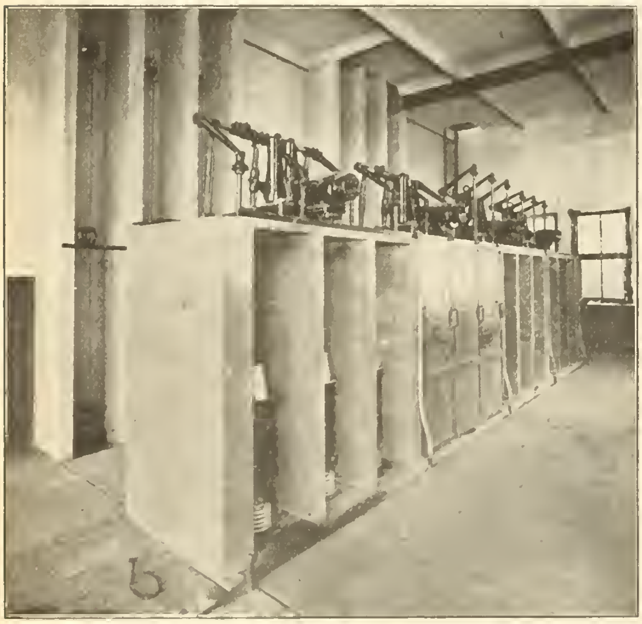
Kaministiquia Power Company—Interior of Substation at Fort William.

manager of the Ogilvie Milling Company, as general manager; Mr. W. L. Bird, superintendent and chief operator; and Mr. C. E. Smith, superintendent of sub-station and the work at Fort William.

Utilization of Power.

The power is used for all branches of service, light, power and railway. Before the plant was completed, contracts had been closed with the following:—Canadian Pacific Railway Company, for 2,200 horse-power; Ogilvie Flour Mills Company, 1,500 horse-power; the Town of Fort William, 600 horse-power; the Canadian Iron & Foundry Company, 350 horse-power; the Consolidated Elevator Company, 250 horse-power; Muirhead & Black, 50 horse-power.

Fort William is growing very rapidly, being situated at the head of the great lakes, and a very large number of industries are locating there in order, first, to obtain reliable electric power at reasonable rates; secondly, to avoid the long freight haul from the distant cities, and, thirdly, because it is possible to



Kaministiquia Power Company High Tension Switches in Substation.

secure raw material of every description from Canada and the United States by means of lake freight.

We desire to acknowledge courtesies from Mr. R. S. Kelsch and Mr. W. R. Bonnycastle in furnishing data and photographs for this article.

STORAGE BATTERY PATENT.

Among several storage battery patents recently granted to an American inventor, one is for a new method of preventing the negative plates from losing their capacity. The active spongy lead is impregnated with an inert material like carbon, and in this way the passageway for the diffusion of the electrolyte into the pores of the plate are maintained intact during service.

A preliminary injunction was issued on July 15th by the United States Circuit Court for the Southern District of New York in the case of the Westinghouse Electric & Manufacturing Company versus the Wagner Electric Manufacturing Company, for the infringement of Stanley patent No. 469809, granted March 1st, 1892. Under this decision, the Wagner Electric Manufacturing Company, of St. Louis, Mo., is forbidden to make, use or sell self-regulating transformers, which infringe this patent, anywhere in the Uniteed States.

THE TURBINES OF THE KAMINISTIQUIA POWER COMPANY'S PLANT.

The generating equipment of the Kaministiquia Power Company's power house at Kakabeka Falls, described elsewhere in this number, comprises at present two generator units and two exciter units. Each unit consists of a turbine with horizontal shaft direct connected to a generator or exciter dynamo respectively.

The turbines were designed and manufactured by J. M. Voith, Heidenheim on Brenz, Germany, the manufacturer of the powerful wheels of the Ontario Power Company at Niagara Falls and of the new double discharge turbines of the Hamilton Cataract Power Company at DeCew Falls, near St. Catharines. Each generator is driven by a central discharge, balanced twin turbine of the Francis or inward flow type.

In spite of the close similarity of the type, the turbines at Kakabeka Falls present an appearance somewhat different from that of the Niagara turbines. Owing to the smaller discharge of the Kaministiquia units the spiral casings of these turbines could be made of cast iron instead of reinforced steel plates, and the intermediate bearing between the two draft elbows could be dispensed with.

The turbines at Kakabeka Falls are designed to deliver 6,570 pounds each under 180 feet head at 275 revolutions per minute. The centre of the turbines is 20 feet above the tail race level, this part of the head being utilized by means of one draft tube for each pair of turbines, built in the concrete foundation.

Each pair of turbines is fed by a separate penstock of 7 feet 6 inches inside diameter. A wicket gate of 6 feet 6 inches inside diameter is inserted before the penstock divides into two branches, one for each spiral casing. The wicket gate can be operated by hand power from the engine room.

The chute cases are equipped with swivel gates carried by shafts which pass through stuffing boxes and are connected by arms and links to a regulating ring, actuated by a hydraulic relay. By this arrangement no parts of the gate rigging are subject to any obstruction by accumulating sand, and the whole mechanism can easily be kept thoroughly lubricated and in good working order.

The swivel gates themselves are open to inspection and conveniently accessible after the removing of a two-parted ring cover.

The shaft of the turbine is provided with two runners of bronze of 5 feet diameter. It has a maximum diameter of about 14 inches and is carried in two self-oiling bearings of ample length. A flange coupling forged to the shafts connects the shafts of the turbine and of the generator rigidly to one another.

For controlling the speed each turbine is furnished with an automatic governor of Voith's approved design. The centrifugal governor is driven by belt and countershaft and distributes the pressure oil to either end of the relay cylinder by means of a control valve and return mechanism. The pressure is generated and maintained by a belt driven high pressure oil pump with oil tank and air chamber.

In order to prevent undue rise of water pressure in the penstock, when the quick acting governor shuts the turbine gates at sudden decrease of load, a relief

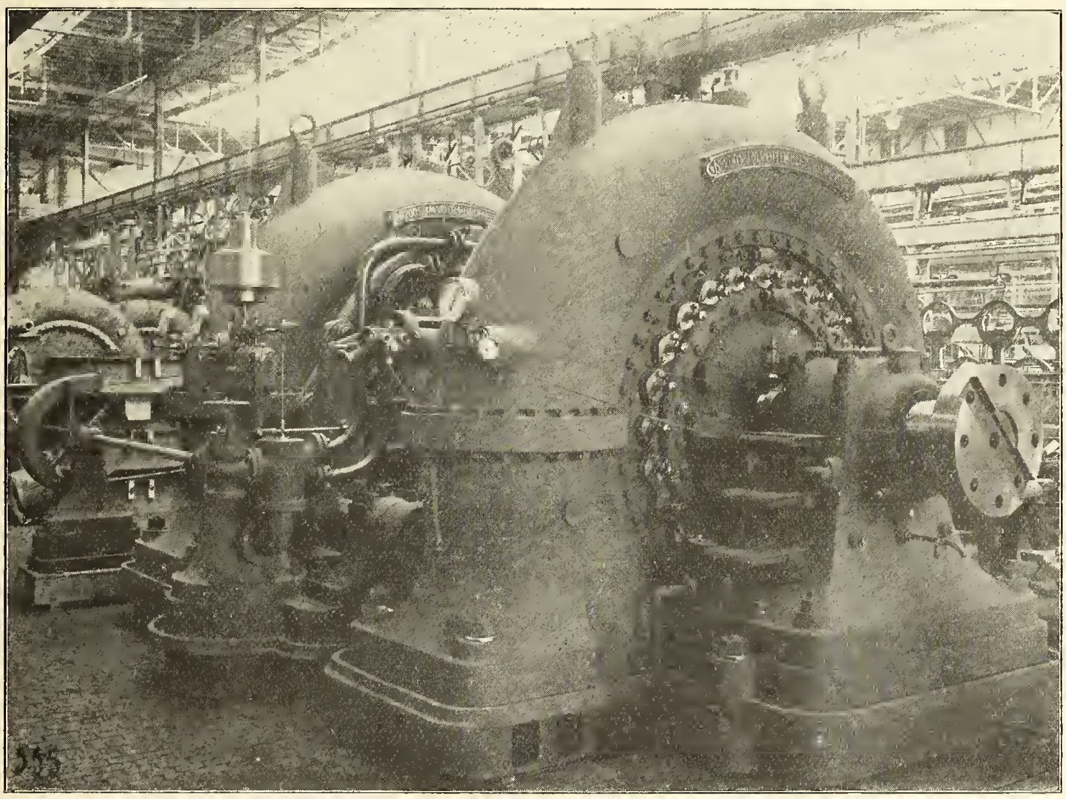
valve is jointed to the foremost end of the distributing pipe.

The exciter dynamos are driven by single wheel, partly balanced spiral turbines rated at 285 horsepower at 500 revolutions per minute. The water enters the cast iron spiral casing from below after passing a main stop valve.

Wicket gates and outer gate rigging resemble those of the generator turbines. The runner is cast of bronze and the shaft carried in two self-oiling bearings. The turbine and dynamo shafts are connected by means of an insulating and flexible belt coupling combined with a flywheel.

The speed of the exciter units is controlled by governors of smaller size working on the same principles as those of the generator turbines. A separate oil pump and the air chamber are located in the base of the centrifugal governor. The pump and the centrifugal governor are driven by belts from the dynamo shaft.

Tachometers, pressure and vacuum gauges complete the equipment of the hydraulic machinery, which in all respects has proved thoroughly satisfactory.



TURBINES FOR THE KAMINISTIQUIA POWER COMPANY.

THERMO-ELECTRIC BATTERIES.

By JAMES ASHER.

It is surprising that so few inventors have bestowed much attention upon the thermo-electric battery. Here we have a device by which heat is directly transformed into electricity.

Mr. Nikola says that few seem to know what is the trouble with this battery. It is not the low efficiency, although this is a great drawback, but it is the fact that the internal resistance rises, or the battery gradually deteriorates while in use. In a few months, or years, the battery becomes useless. Mr. Tesla once told me that he thought it utterly impossible to obtain an efficiency of more than two per cent. It is said that this efficiency has already been attained.

Noe's thermo-electric battery does not deteriorate after long use. This device is used in Austria and Germany. In trying to obtain success let us use M. Noe's elements. Let us in addition apply a few common principles of electrical science. We may considerably reduce the resistance of each element. The current strength is always equal to the voltage divided by the ohmage. We may apply simple physical principles in order to economize heat. Look at Noe's battery. Naked gas flames are placed near the elements. The hot gases part with little of their heat at the metallic junctions, so that much is wasted. The temperatures of the two ends of each element should be kept at those which have been found the proper temperatures for the elements concerned. There is no advantage in merely making one set of junctions much hotter than the other without regard to the diagram of temperatures and potentials for the elements concerned. It is said that there is seldom any benefit in keeping one face of a thermo-electric battery at a temperature of more than 100 degrees higher than the other.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Canadian Association of Stationary Engineers held their annual convention at Guelph, August 14th and 15th. The following officers were elected for the ensuing year:—President, Ed. Grandbois, Chatham; vice-president, Chas. Kelly, Chatham; treasurer, A. M. Wickens, Toronto; secretary, W. A. Crockett, Hamilton; conductor, W. McGhie, Toronto; doorkeeper, J. J. Heeg, Guelph. The next annual meeting will be held in Windsor.

HYDRO-ELECTRIC POWER DEVELOPMENT

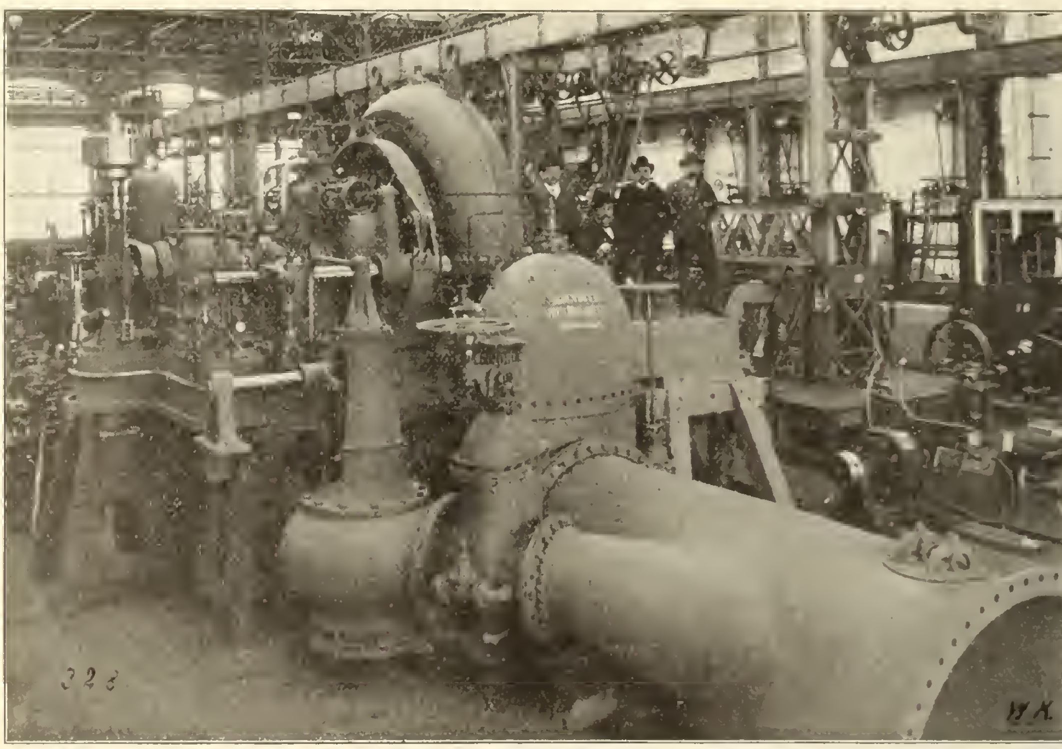
With Special Reference to Long Distance Power Transmission, and Some Turbines of Large Unit Capacity, Operating Under High Heads of Water.

By Wm. Kennedy, Jr. Hydraulic Engi eer.

Previous to the successful long distance transmission of power, electrically, for commercial purposes, many waterfalls which are now of great value, and particularly where these falls were of very considerable height (say 100 feet or more for the purposes of this article), were of very little practical use, as such high falls are generally situated in more or leess inaccessible places, and hence unsuited for the location of industrial manufactories.

Successful long distance transmission of power electrically at high voltage has, however, so changed the conditions that the question of distance between the power site and the point at which the power is used, up to, say, 50 miles in localities where fuel for steam power is considered fairly reasonable in cost, and as far as 150 miles, or even a greater distance, where fuel is very expensive, I say the question of distance from the water power generating station to the manufacturers' works is not now a matter of great importance; and this fact has, naturally, and very rapidly, brought into use these high head falls, and made them in many instances of great commercial value. Manufacturers may now place their works in such localities as will best meet their requirements, such requirements as delivery of the necessary raw materials to the works, shipment of their finished products, and labor conditions, these latter becoming more and more a matter of vital importance to manufacturing interests. Experience has fairly well proven that localities convenient to the large centres of population are, generally, most suitable for procuring and the management of labor for general manufacturing purposes.

The use of water power under high heads has also made great changes in the design and manufacture of turbines and turbine governors, owing to the very different conditions under which these machines have to work, and the requirements exacted from them, as compared with the older conditions and requirements generally. Under the older conditions, comparatively low heads of water, where the speed of the turbines was comparatively slow, and of less capacity in units of power, also where the owners of the manufactories owned or controlled the water power sites and the turbines, there was not the same necessity for the high class design, manufacture and materials in the turbines, and the excellence of turbine governors, that is now necessary where the turbines operate large units of power under high heads of water—say from 3,000 to 12,000 horse-power units—fast running and direct connected to electric generators; and where, as is generally the case, the power supplied is divided up amongst many customers in different cities and towns, and used under conditions varying from the steady power and even voltage required for satisfactory incandescent lighting in private houses, to the extremely varying power conditions of electric railway and rolling mills use—and such varying conditions the power companies have to meet and are now very successfully meeting every day.



6,000 H. P. Turbine for the Hamilton Cataract Power Light & Traction Company.

It will very readily be seen that stoppages or irregularities of speed in turbines and turbine driven machinery that were at one time looked upon as quite reasonable will not now be tolerated, notwithstanding the extremes of operating conditions imposed as above mentioned. Turbines, and the entire hydraulic equip-

ment, including the governors regulating the speed of the turbines, must also be prepared to take care of almost instantaneous total changes of load brought about by short circuits on the transmission lines, thus requiring a perfection of turbine equipment and turbine governors not even dreamed of a comparatively few years ago.

Strange to say, the so-called Francis turbine, a development of this country (America), has had until recently, if not even at the present time, its highest development in European countries; and from these countries the turbines, or designs for them, for most of the large and high head powers have been brought. These conditions are, however, being rapidly changed, so that high class turbines and governors are now being made in America; but it may be mentioned, incidentally, that some of the best turbine manufactories in America have European trained engineers in their draughting rooms as turbine designers.

As illustrating the number of European-made turbines, or turbines made from European designs, in some large power plants now in use, I mention the Niagara Falls Power Company, operating on the United States side of the Niagara river with twenty-one turbines, aggregating 105,000 horse-power; the Canadian Niagara Power Company, with five turbines, say 60,000 horse-power capacity, and the Ontario Power Company, four turbines, say 50,000 horse-power, these two last mentioned companies operating at Niagara Falls on the Canadian side of the Niagara river; the Dominion Power & Transmission Company of Hamilton, Ont., with power house near DeCew Falls, Ont., six turbines aggregating 26,000 horse-power; the Kaministiquia Power Company's plant with two turbines, say 12,000 horse-power; and the Shawinigan Water & Power Company, Shawinigan Falls, Que., with one turbine, say 5,000 horse-power, or a grand total of European-made turbines, or turbines made directly from European designs, amounting to fully 250,000 horse-power, with provision for doubling this amount.

The heads of water used at the power houses mentioned are, approximately, Niagara Falls Power Company (United States), 136 feet for ten turbines in No. 1 power house, 141 feet for eleven turbines in No. 2 power house, and about the same at the Canadian Niagara Company's power house; Ontario Power Company, 175 feet effective head; Dominion Power & Transmission Company, 265 feet head; Kaministiquia Power Company, 175 feet effective head; Shawinigan Water & Power Company, 135 feet head.

The writer, as the hydraulic engineer for the Dominion Power & Transmission Company (formerly the Hamilton Cataract Power, Light & Traction Company), visited Europe twice to take tenders and make contracts for turbines for that company, and also subsequently visited Europe and took tenders for the Ontario Power Company's turbines. The turbines procured for the first named company developed a little over 7,000 horse-power per unit, and the Ontario Power Company's turbines at their test developed 14,000 horse-power per unit on the turbine shaft —in each case being the most powerful water driven units that the writer knows of at the respective times at which they were put into operation. The writer was also hydraulic engineer for the Kaministiquia Power Company during the time of the construction of the turbines above referred to.

The turbines brought from Europe, or of European design, so far as tested, have given excellent results as to efficiencies, and have proved very satisfactory in use; the same may also be said of the turbine governors.

The power now generated, and to be generated at the power stations above mentioned, is used or to be used at distances varying from, say, half a mile from the power station to probably 100 miles, thus showing the development, within a comparatively few years, of long distance power transmission electrically.

THE QUEBEC BRIDGE BUILT BY ELECTRIC POWER.

The Quebec bridge across the St. Lawrence river, to which reference was made in our last number, is the longest single span bridge in the world, the total length between abutments being 3,220 feet. It is interesting to note that the entire work of erection is being done by electric power from apparatus supplied by Allis-Chalmers-Bullock, Limited, Montreal. Alternating current at 2,400 volts is delivered by the Canadian Electric Light Company to two sets of motor generators made by Allis-Chalmers-Bullock and located in a sub-station on the approach span, and then goes out at 550 volt direct current to the engines on the traveller and all other motors on the work.

All riveting, drilling and reaming is done by compressed air, furnished by two Herron & Bury compressors, made by the Bury Compressor Company, of Erie, Pa., and driven by General Electric motors.

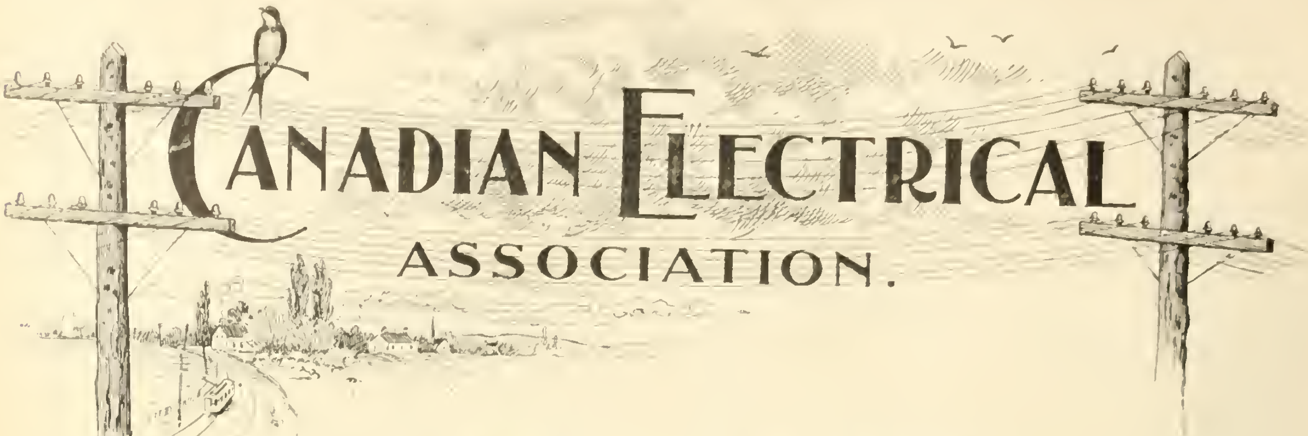
This being one of the first times electric power has been used on structural steel erection work of any magnitude, the outcome of the experiment has been watched with interest, and the fact that no delays or breakdowns have yet been experienced speaks well for this power for such use in general, and for this installation in particular.

The absence of smoke, noise and confusion is especially noticeable to a visitor at the bridge site, due chiefly to the admirable electric installation for handling all lifts.

An attractive booklet describing the Quebec bridge has recently been issued by two of the engineers, Messrs. E. R. Kinlock and N. R. McLure, of New Liverpool, N.S.

The City of Revelstoke, B.C., is asking for tenders up to September 9th for additional equipment and re-arrangement of the hydro-electric plant, comprising 500 B.H.P. producer gas plant and gas engines, generators and exciters, transmission apparatus, switchboards, wiring and re-arrangement of present plant. Mr. Cecil Goddard, C.E., is the chief engineer for the city.

The Calgary Power & Transmission Company are about to commence work on their power development scheme at Calgary. The first actual work to be done is to divert the water from its present course through the gorge. This will be accomplished by tunnelling through the cliff. Mr. Garnet P. Grant is the general manager of the Calgary Power & Transmission Company, while Mr. C. H. Mitchell, of Toronto and Niagara Falls, is the consulting engineer.



THE MONTREAL CONVENTION

On the opposite page will be found the programme, subject to revision, of the seventeenth annual convention of the Canadian Electrical Association, to be held in Montreal Wednesday, Thursday and Friday, September 11th, 12th and 13th. It will be observed that the list of papers is a lengthy one, the committee having been particularly successful in inducing a number of gentlemen prominent in the engineering and operating fields to contribute to the convention programme. It is expected, however, that there will be ample time for a free and general discussion of the various topics, and the members are requested to read carefully the advance copies of the papers which are placed in their hands, so as to be prepared to ask questions and bring out the points of interest. One object which the central station man has in attending a convention of this kind is to widen his knowledge of operating methods, that he may improve the efficiency of his plant. This he may do by learning of some better system of operation or of some new devices or apparatus. When to the list of papers is added the Question Box, so ably conducted by Mr. A. A. Dion, it can safely be predicted that there will be something to learn by everybody at this year's convention.

MR. R. G. BLACK,
President Canadian Electrical Association.

The meeting room will be the Assembly Hall of the Canadian Society of Civil Engineers, 413 Dorchester street west, while the convention headquarters and bureau of information will be at the Windsor Hotel.

The entertainment programme has not been finally completed at time of writing, although it has been arranged that there will be a theatre party on the evening of the 12th and a tea for the ladies in the afternoon, while special cars will be provided for those who wish to go to the race track Friday afternoon. Dominion Park will be visited Friday evening.

Doubtless the greatest attraction will be the Electrical Exhibition in the Drill Hall on Craig street. This will be visited by the members on Wednesday evening. The management of this Exhibition have spent a large sum of money to provide special features, which will interest and please not only the electrical people, but the public at large. Each visitor will be given a souvenir. Members of the Canadian Electrical Association should take their wives and daughters with them, and give them an opportunity of witnessing the numerous applications of electricity of the present day.

The railway and steamship lines comprising the Eastern Canadian Passenger Association have granted the usual rate of fare and a third for the round trip, provided fifty or more certificates are obtained.

The Local Committee in charge of arrangements consists of Messrs. Henry D. Bayne (chairman), Alderman Sadler, J. W. Pilcher, E. F. Sise, L. J. Belnap, Watson Jack and D. McDonald. There will be a special meeting of the Canadian Street Railway Association in Montreal September 12th and 13th, and the two associations will probably join for entertainment purposes.

CONVENTION REGISTER.

Allis-Chalmers-Bullock, Limited, will publish again at intervals during the convention the register of those in attendance, which has proved a useful feature of previous conventions. Those registering are given buttons, numbered consecutively, and the corresponding number is printed with the name and address. This affords an easy and accurate way of identifying members. As a large attendance is confidently expected, in view of the Exhibition and other attractions, it should this year be of even more advantage than usual to those in attendance.

Canadian Electrical Association—Convention Program

WEDNESDAY, SEPTEMBER 11

9.30 a.m.—Meeting of Managing Committee.
10.30 a.m.—Opening Session.
Minutes.
President's Address.
Reports and Communications.
11.00 a.m.—"Electric Heating and Cooking Devices," by MR. A. B. LAMBE.

AFTERNOON SESSION.

2.00 p.m.—"Trials of the Operating Man," by MR. M. A. SAMMETT.
"Three Wire Generators," by MR. B. T. McCORMACK.
Question Box.

EVENING.

Visit to the Electrical Exhibition.

THURSDAY, SEPTEMBER 12

MORNING SESSION.

9.30 a.m.—"The History and Development of High Tension Insulators," by MR. CLARENCE E. DELAFIELD.
"The Value of the Nernst Lamp to the Central Station," by MR. A. E. FLEMING.
"Incandescent Lamps," by MR. J. M. ROBERTSON.
Question Box.

AFTERNOON SESSION.

2.00 p.m.—"Frazil and Anchor Ice: The Difficulties They Cause at Hydraulic Plants; Some Remedies," by MR. JOHN MURPHY.
"The Load Factor," by MR. R. M. WILSON.
In the afternoon a tea will be provided for the ladies at the Royal St. Lawrence Yacht Club.
4.30 p.m.—Executive Session.

EVENING.

Theatre Party—Particulars will be given in a Program of Entertainment to be obtained during the Convention.

FRIDAY, SEPTEMBER 13

MORNING SESSION.

9.30 a.m.—"Modern Lighting Transformers," by G. P. COLE.
Paper by MR. GEO. H. MONTGOMERY.
Naming of Standing Committees.
Next Place of Meeting.
Unfinished Business.

AFTERNOON.

Special cars will be provided to the Race Track

EVENING.

Visit to Dominion Park.

Mr. Henry D. Bayne, Chairman.

Mr. J. W. Pilcher.

Alderman Geo. W. Sadler.

Mr. Watson Jack.

Mr. D. McDonald.

Mr. L. J. Belnap.

Mr. E. F. Sise.

MEMBERS OF THE LOCAL COMMITTEE CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

MONTREAL LIGHT, HEAT & POWER COMPANY'S NEW HEADQUARTERS.

Ever since the organization of the Montreal Light, Heat and Power Company, and the combining of the numerous companies represented in this corporation, it has been very generally recognized that large office quarters were a necessity, and that the only manner of obtaining what was desired was to build for themselves.

The company have therefore erected at the northwest corner of Craig and St. Urbain streets a fine office building of about one hundred feet high, capable of not only taking in the entire office staff, but of giving in addition numerous offices which may be leased to advantage.

New Office Building of the Montreal Light, Heat & Power Company.

The structure consists of seven storeys and a basement, in all 100 feet high. It is an office building of the most modern type, absolutely fireproof and of skeleton steel construction. The exterior is of exceedingly handsome and dignified appearance, but little ornamented, acquiring its beauty from the strength and simplicity of its design and from its studied proportions. Both the Craig and St. Urbain street fronts are of Indiana limestone, with Stanstead granite to the height of the first storey windows.

There are two entrances from Craig street, one leading directly into the main office of the company, and the other to the elevator hall. An entrance from St. Urbain street is also provided for the use of the employees.

The vestibules have high marble wainscots with vaulted ceilings, and the main halls marble dadoes and ornamental beamed ceilings. The main office of the company is spaciously and conveniently arranged for the public, with a show room for gas or electric cooking and heating appliances.

Such woodwork as is of necessity used in the finishing of the building is of white oak with a natural finish, and all the offices have excellent lights. The upper floors have large corridors with marble base and terrazzo floors, iron and marble staircases and high speed elevators, making the offices among the most desirable in the city.

The company will occupy the three lower storeys and the top storey for their exclusive use.

Mr. Kenneth C. Rea is the designer of the structure.

The New Hydro-Electric Plant of the Sherbrooke Power, Light & Heat Company

The Sherbrooke Power, Light & Heat Company have had in operation for the past nine months a new hydro-electric plant of interesting design and construction. The company was originally established in 1888. The plant consisted of a brick building erected on a small island in the middle of the river just below the main dam, as shown in Figure 1. The waterwheels for this plant were placed at the lowest possible point on the right-hand side of the power house, and the power from the waterwheels was transmitted to the generator by means of belts.

The original plant consisted of two 240 kw. 2,400 volt Stanley two phase 133 cycle generators, and one 360 kw. 2,400 volt Stanley two phase generator.

In 1905 the company concluded that, owing to the rapid development of the city and the increasing demand for power, the plant would in a short time be overloaded to such an extent that something would have to be done to relieve the situation, which was aggravated by the low power factor and difficulty experienced in operating the Stanley two phase motors. At first it was thought advisable to re-construct the existing power house with a view to bringing the same up-to-date as near as possible. It was finally decided to call in the services of a consulting engineer, and this resulted in the company reaching a decision to abandon the original power house, as a power house, and construct an entirely new building and plant, making the same up-to-date in every respect.

Plans and specifications were prepared and contracts let, and the work completed without a single hitch or accident of any kind.

The new plant is shown in Figure 2, and it will be seen that it has been built, so to speak, down in the bed of the river, between the island supporting the old plant and the forebay. In this view, we see the wires entering the new power house under the copper covered entrance for the wires, showing a gallery for making these wires accessible, which view also shows the method employed for ventilating the power house, which was situated so low that it would be very warm at certain seasons of the year, when the plant was operating to its maximum capacity.

The power house is lighted by means of two skylights glazed with fireproof glass and so arranged that the lighting effect in the day time is remarkably good, as will be seen by referring to Figure 3, which shows the waterwheels, generators, waterwheel governors, and a portion of one of the waterwheels for driving the exciter. There are two exciters, either having sufficient capacity for operating three generators.

Figure 4 shows No. 2 exciter, switchboard gallery, switchboard, etc. In the lower left-hand corner of Figure 4 will be seen a portion of one of the waterwheels used in the original plant. This waterwheel will be utilized for driving No. 3 generator in the new plant, which will be of the same capacity as the two now installed and will be located in line with the same. This waterwheel is supplied by two pipes which enter the wall of the old power house, and are clearly shown in Figure 5. These pipes enter the wall of the old building, the portion of which—or the corner shown in this figure—has been made part of the new plant. In this figure we also have a good view of the method of bringing out the wires in the new plant.

The new power house is constructed with fireproof material throughout. The foundations and walls are made of concrete. The roof, which is constructed of concrete, is supported with steel trusses, and the window frames, sashes, skylights, etc., are all made fireproof, being constructed of galvanized iron and wire glass. The lighting effect in the day time is remarkable, and the temperature of the power house can be kept exceedingly low by means of the small ventilat-

Fig. 1 View of Original Power House.

ing fans, notwithstanding the fact that the power house site is 80 feet below the average level of the city, and actually surrounded on four sides by walls, dams, etc.

The switchboard and electrieal apparatus were furnished by the Canadian General Electric Company, and consists of the following:—

Two 625 k.v.a. 225 r.p.m. 60 cycle 2,300 volt 3 phase generators; two waterwheel driven 35 kw. 125 volt 600 r.p.m. exeiters.

The switchboard consists of six single phase panels; five 3 phase power panels; three generator panels, and one exciter panel.

Each line is equipped with an automatic oil circuit breaker eontrolled by time limit overload relays. The single phase circuits are so arranged by means of transfer switches that any single phase circuit can be transferred to any phase of the three phase system for equalizing the load on the three phase bus bars.

The instruments are mounted on blue Vermont marble panels, and the switchboard is placed 10 feet from the rear wall. The lightning arresters are placed on a board covered with asbestos on each line as it enters the station on the rear wall.

In addition to the regular instruments for operating the various circuits, generators, etc., a special frequency indicator is shown on the left-hand wall,

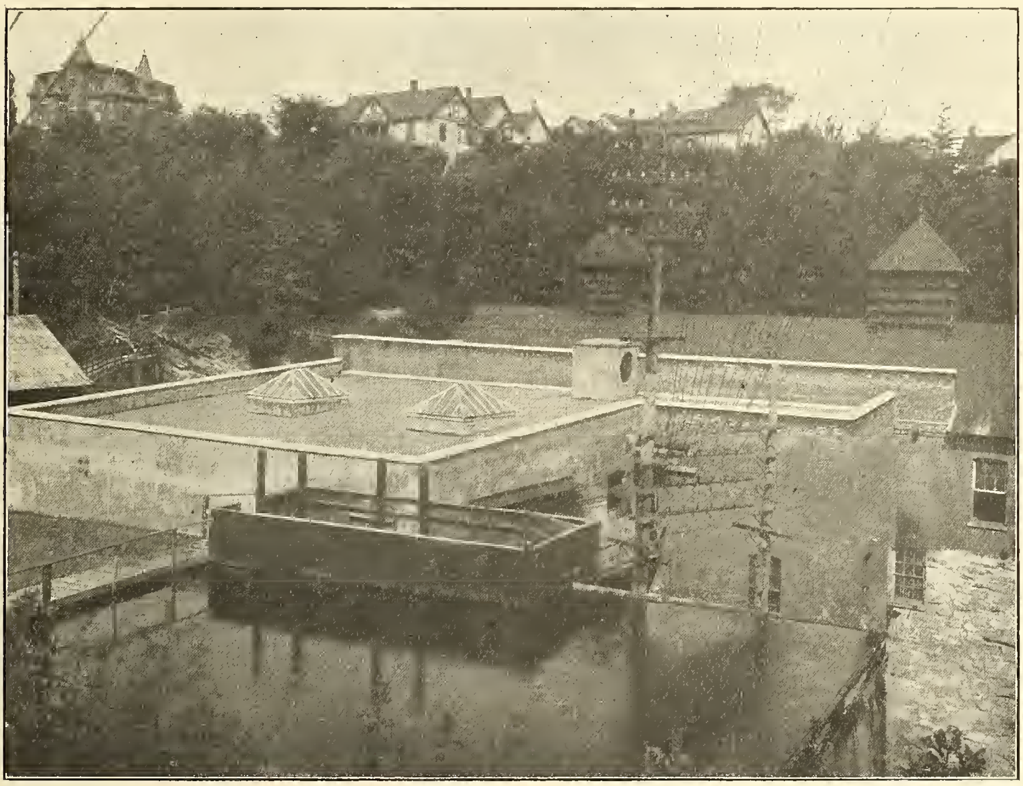


Fig. 2—View of New Plant, Showing Method of Ventilation.

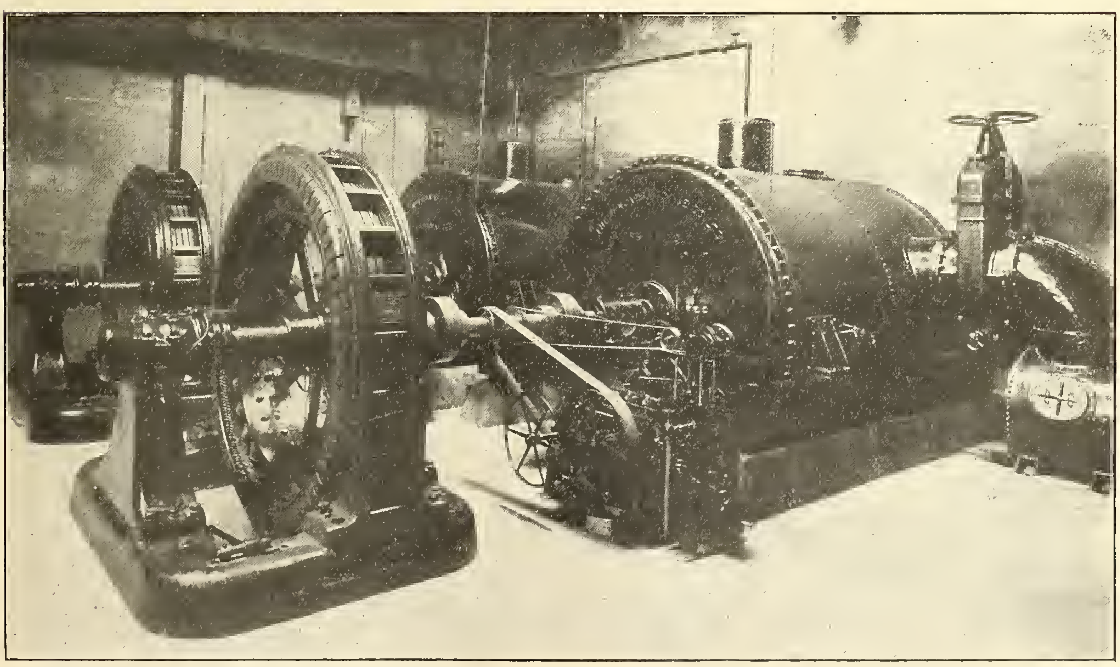


Fig. 3—View of Waterwheels, Governors and Generators.

from which the operator can see at all times the exact speed of the apparatus, also the synchronizing indicator and the recording voltmeter.

The waterwheels consist of two units, each unit comprising two 35 inch runners, guaranteed to develop 875 horse-power at 225 r.p.m.

The exciter waterwheels have a capacity of 50 horsepower each at 600 r.p.m. Each exciter waterwheel receives its supply of water from separate sources, so that in the event of repairs being necessary to either section of the plant, it will not interfere with the operation of same. The waterwheels are regulated by means of Lombard governors, located as shown in Figure 3.

The hydraulic equipment of the power house was constructed and installed by the Jenckes Machine Company, of Sherbrooke.

The new plant was put in operation last December, since which time a large amount of new business has been contracted for. At the present time the Power Company are supplying power to the Jenckes Machine Company, Canadian Rand Drill Company, Quebec Central Railway Company's shops, and many other smaller concerns, having in all about 500 horsepower in motors, 24,000 incandescent lamps and 100 arc lamps. The outlook is also very promising, as the demand for electric power is increasing daily.

The entire new plant was designed and contracted for by Mr. R. S. Kelsch, of Montreal, the company's consulting engineer, and installed under the supervision of Mr. A. Sangster, superintendent for the Sherbrooke Power, Light & Heat Company.

The Hamilton Board of Works recently opened tenders for gas and electric lights. The Cataract Company quoted $60 a lamp for a ten-year contract and $65 for five years for five hundred arc lamps. W. A. Logie, of Chisholm & Logie, on behalf of an unknown company, offered to supply 500 arc lights at $55 for ten years and $60 for five years. The present price averages about $82.50. The American Street Lamp Company offered to supply 500 gas lamps, including everything, at $31 for five years and $30 for ten years. The Hamilton Gas Light Company's price was $31.50 for five years and $28.50 for ten years.

LIGHTING TRANSFORMER BULLETIN.

Messrs. Allis-Chalmers-Bullock, Limited, have recently issued a bulletin, No. 300, describing their standard lighting transformers. It contains numerous illustrations, including diagrams showing connections for different voltages. For their standard line of lighting transformers, Allis-Chalmers-Bullock, Limited, employ the "core" type, which is now almost universally recognized as the best all-round type for lighting service. Their transformers are oil-filled and self-cooled, and possess the following good points: (1) Low core loss; (2) high efficiencies at all loads; (3) low temperature rise; (4) good regulation; (5) strong mechanical design.

Fig. 5—View of Pipes to Waterwheels.

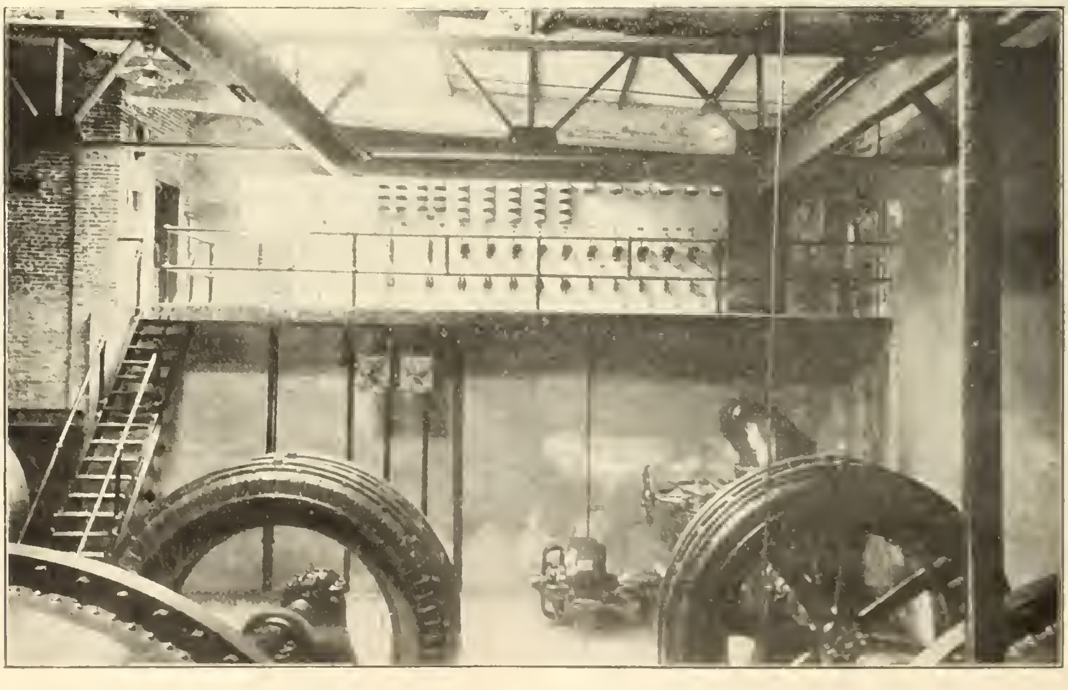


Fig. 4—View of Switchboard, No. 2 Exciter and Portion of Waterwheel.

WOOD POLE LINE CONSTRUCTION

By A. B. Lambe.

An electric plant consists broadly of three main divisions, namely, the generating or producing end, the motors and lighting devices, or the utilization end, and the connecting link between them, the line. The first two usually receive very careful consideration on the part of both the customer and the manufacturer, but the line does not as a rule seem to come in for its share, notwithstanding that it is just as necessary and just as important as the balance of the plant. Further, it does not get the same attendance and inspection after being put into operation as does the rest of the equipment. As compared with this condition we find that underground work is generally given more attention and put in on a relatively higher plane, though the situations where such construction is commercially possible are comparatively rare, this being true for the great majority of Canadian plants, owing to the low density of population. Nevertheless the different standards of construction, doubtless in part at least, account for the general feeling that overhead work is comparatively unreliable, and this, together with the unsystematic way in which it is too often erected, without question frequently add fuel to the popular clamor against overhead wires.

On the other hand it is obvious that there is an immense electric light and power field which cannot be served by any other method, except at rates which would be absolutely prohibitive, and so it becomes incumbent upon every company operating overhead lines to see in the first place that they are erected in a thorough and systematic manner, and secondly, that they are maintained in good repair. If this be not done the interruptions to the service will inevitably be so frequent and so costly as to seriously hamper the growth of what would otherwise be most flourishing systems, even if in the end they do not bring them down to a mere struggle for existence.

Right of Way.

About the first thing to be considered in erecting a pole line is the right of way. The great majority of plants, particularly those not employing transmission lines, use the streets and highways, both from considerations of first cost and convenience in reaching their customers, obtaining the right to occupy public ground from their charters. Most transmission lines of moderate capacity and voltage also take the same route, though for the larger systems and higher potentials a purchased right of way is generally desirable. For this there is usually required 40 feet to 60 feet on each side of lines running through ordinary bush, more if the trees be unusually tall, and 15 to 20 feet for lines through clear ground. These figures cover single lines only, and must be increased by the 12 foot or 15 foot clearance necessary between twin transmissions. When starting to erect lines on streets particular attention should be paid to the other circuits already there, care being taken to as far as possible run on the side not already occupied, telephone and telegraph systems being just as objectionable as lighting and power lines. Trees also are a point to be most carefully considered, it being naturally most desirable to keep away from them as far as possible. Your street and side, however, once chosen, should be adhered to as strictly as possible, because crossings only add to the expense of the system and increase the chances of trouble, besides being most unsightly.

Feeders, Mains and Services.

If the generating plant be so located, with reference to its load, as to make the question of drop one which has to be considered, it is customary to lay out the lines on what is called the feeder and main system. This arrangement consists in dividing the overhead wiring into three distinct parts, feeders, mains, and services, these either being all at substantially the same pressure, as in direct current work, or at materially different voltages, as in alternating plants. The mains are the circuits run in proximity to the load, and designed so that the voltage is approximately constant throughout their length. The services are those lines, usually small and short, which connect each group of lights to the mains, the drop in the two together being kept as a rule within two per cent. The feeders are that part of the system connecting the power house to the mains, the point at which they join the latter being called the centre of distribution. Most of the losses in the system are concentrated in the feeders, which are usually calculated so as to have a drop that is seldom less than 5 per cent., and which should not exceed much more than twice that as a maximum, 8 per cent. to 10 per cent. being a fair average. In consequence of this large drop it is not permissible to connect services directly to feeders, except under unusual circumstances, though the point is not so important in motor work. The voltage on the mains is kept within the required limits either by compensating voltmeters, by pressure wires, or by a table of power house voltages corresponding to different loads. If there be more than one set of feeders and mains all the drops must be made practically equal, otherwise, in the absence of feeder regulators, the voltages on the lamps will vary beyond permissible limits.

Comprehensive formulae for the calculation of line losses may be found in various standard works and in different trade publications, but the following simple equation is correct for direct current circuits, besides being fairly accurate for single phase alternating work when the wires are of medium size and the power factor is high, viz.:

$$\frac{\text{Amperes} \times \text{One Way Feet} \times 22}{\text{Drop in Volts}} = \text{Circular Mills.}$$

or transposed—

$$\frac{\text{Amperes} \times \text{One Way Feet} \times 22}{\text{Circular Mills}} = \text{Drop in Volts}$$

Another handy rule, easily memorized, is as follows, viz.:

"A No. 6 three phase line will carry 100 kw. .33 miles with an energy loss of 10 per cent., the delivered potential being 1,000 volts, and the power factor being 85 per cent."

This figure of 85 per cent. can be assumed as a fair average for a mixed load of motors and lights.

With this as a basis the size of wire for any given conditions can be quickly ascertained within very close limits, remembering that the circular mills vary directly with the energy loss, the load transmitted, and the distance, and inversely as the square of the voltage. Starting with the above laid out in equation shape, as follows, viz.:

100 kw. for .33 miles, for 10 per cent. loss, at 1,000 volts = 26,250 C.M.,

we would find the wire required for transmitting 300 kw. 12 miles with 5 per cent. loss, the delivered potential to be 10,000 volts, by the following equation, viz.:

$$\text{Required C. M.} = \frac{300}{100}\text{(K. W's)} \times \frac{12}{33}\text{ Miles)} \times \frac{(1,000)^2}{(10,000)^2}\text{(Voltages)} \times \frac{10}{5}\text{(Losses)} \times 26,250\text{ (C. M. of No 6 Wire)}$$

This reduced gives 57,270 as the required circular mills.

The nearest size to this is a No. 3 wire, which, as it is a little smaller than required, viz., 52,630 C. M. as against 57,270 C. M., will give a slightly greater drop than 5 per cent.

Poles.

In constructing a pole line the next essential is of course a good set of poles, because if these be poor or unsightly the best of labor and the finest of other materials will never produce a good line. In eastern Canada the almost universal wood for this purpose is cedar, as it grows to the requisite dimensions and gives the best life, though in other localities woods of local growth, which can in consequence be more readily obtained, are frequently used, for instance, chestnut in the eastern States and redwood in California. The quick-growing hardwoods and the slow-growing pines and cedars make the longest-lived poles, well-grown, mature trees last longer than those which are very young or very old, a natural round or split pole will outlast one which is sawn, as will a pole cut when the sap is down, say October to April, as compared with one cut at other seasons of the year. The actual life naturally varies considerably, but 10 to 12 years may be taken as a fair average, this assuming that the pole was well seasoned before being used, as neglect of this precaution may reduce the life as much as 50 per cent. Quite a number of pole preservative processes have been introduced, such as creosoting, but none of them are used in this country, outside of course of tarring the butts, which is of undoubted value.

The most standard size is 30 feet over all, with not less than 6 or 7 inch tops, the latter preferred, and with 11 inch butts. Longer poles are of course necessary for many lines, besides which, as a pole rots first at the ground line, they have the advantage of still being available for duty somewhere else after being cut off. The gains, usually 1 inch or 1 1-2 inches deep, and placed 9 inches from the peak and 24 inches apart, should always be painted, as should also the roof. In addition to this it is desirable to paint the pole all over, one coat before it leaves the yard, and another after all line work is finished. All 30 foot poles on straight lines should be set in the ground at least 5 feet, this being increased to 5 1-2 feet on corners and curves. Larger poles should also be set somewhat deeper, 7 feet being about right for a 60 foot pole. These figures are all for earth work, and can be reduced about 2 feet for rock setting. When crossing hollows or rises care should be taken to avoid abrupt changes in the level of the line wires by using poles of suitable length. All poles which have to be climbed frequently, such as those carrying transformers, lights, etc., should be stepped. The usual centres for these are 30 inches, care being taken to keep them in line with the street, those at the bottom usually being either removable or else made of wood. On straight line work poles are usually spaced 110 to 125 feet for lines of medium capacity, though for transmission lines in clear country, with good poles, and wires not exceeding No. 1, spacings up to 150 feet are allowable. For conductors larger than this it is advisable to reduce the pole centres to about 100 feet. On curves all these figures have to be reduced by 30 to 50 per cent., dependent on the degree of curvature. Seasoned cedar poles weigh about 400, 600, 850 and 1,000 pounds for 30, 35, 40 and 45 feet respectively, an unseasoned pole being about 20 per cent. heavier. A 30 foot cedar pole with an 11 inch butt, and set 5 feet in the ground, will stand a side strain on the top cross arm of some 2,500 pounds before it will break, the fracture as a rule being near the ground.

A set of pole specifications for a good line would read about as follows, viz.:

"All poles are to be cut, when the sap is down, from live growing cedar timber, the tops and butts to be sawn square, and the poles peeled and knots trimmed close. The tops must be sound and must not be less than 7 inches in diameter, with butt diameters of 11 inches, 12 1-2 inches, 13 1-2 inches and 14 1-2 inches respectively for 30, 35, 40 and 45 foot lengths. No pole may have more than one bend, this bend to be in one direction only, the sweep not to exceed 1 inch for every 6 feet of pole length. Large knots are not to be considered a defect if sound, nor is a perfectly sound dead or dry streak, if it does not impair the strength of the pole. Butt rot is permissible to the extent of 10 per cent. of the area of the butt, but it must not extend far enough up the pole to impair the strength above ground."

Cross Arms.

Cross arms were at first made from long-leaf yellow pine, but red pine is now the standard for the great

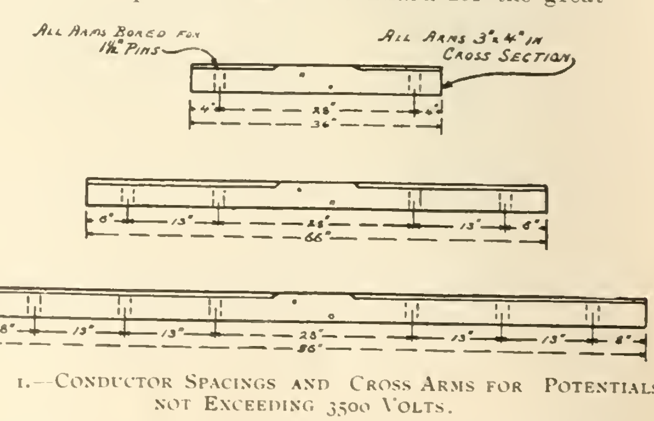
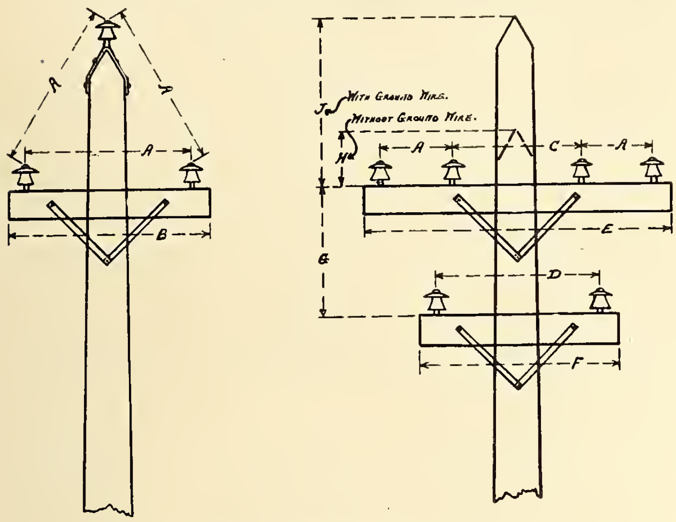


Fig. 1.—Conductor Spacings and Cross Arms for Potentials not Exceeding 3500 Volts.

majority of lines. The usual dimensions for city work and for medium sized transmissions are shown in Fig. 1, for heavier lines 3 1-2 inches x 4 1-2 inches, 4 inches x 5 inches and 4 inches x 5 1-2 inches are the sizes most generally used, the lengths of arms and conductor spacings being shown in Fig. 2. The figures

given therein are the minimum desirable, and can be somewhat increased without disadvantage, except in the case of double circuit high voltage lines, in which latter the length of the upper arm tends to become excessive. In view of this twin lines for potentials exceeding 25,000 volts are sometimes erected on two sets of poles, set about 7 to 9 feet apart, with a cross arm running from one to the other. This arm carries four of the six wires, the other two being at the tops



All Dimensions in Inches.

Voltage.	A	B	C	D	E	F	G	H	J
3500—7000	18	26	40	50	84	58	24	9	48
10000—20000	24	32	40	52	96	60	24	9	60
20000—30000	30	42	48	60	120	72	30	10	66
30000—40000	36	48	60	70	144	82	36	10	70

Fig. 2.—Conductor Spacings and Cross Arms for 3500 to 40000 Volt Circuits.

of the poles. This design makes a most excellent line, and one that requires but little guying or bracing, the only disadvantage being the somewhat higher cost as compared with the arrangement shown in Fig. 2. It should be noted that, while three phase transmissions are generally arranged in the form of an equilateral triangle, this is by no means obligatory.

The arm as a rule is fastened to the pole by two 7 inch x 1-2 inch lag screws, but one through 5-8 inch bolt makes better construction. The arms should always be faced against the maximum strain, such as the upper side of the pole on hills and on the far side from the line at ends, on straight level line being placed on alternate sides of the poles. For distribution circuits it is customary to brace all arms carrying more than two pins, sometimes even these latter when the wires are very large or unbalanced. In transmission lines every arm should be braced. The most common brace is made from ordinary 1 inch x 1-4 inch flat iron, sometimes one cut from angle iron is used, though it is not really justifiable except on very heavy work.

All corners, ends, and heavy curves, together with any other points of unusual strain, should be double armed, spacing blocks of wood or iron being inserted between the two arms. In addition to this all corner arms should be equipped with guard hooks, to prevent the falling of any wires which may get away from both insulator and pin.

Cross Arm Pins.

In the great majority of Canadian lines the cross arm pins are oak or birch, though for high tension work, requiring longer pins, locust and eucalyptus are sometimes specified on account of their greater strength. The standard size for all ordinary work is shown in Fig. 3, an oak pin of these dimensions

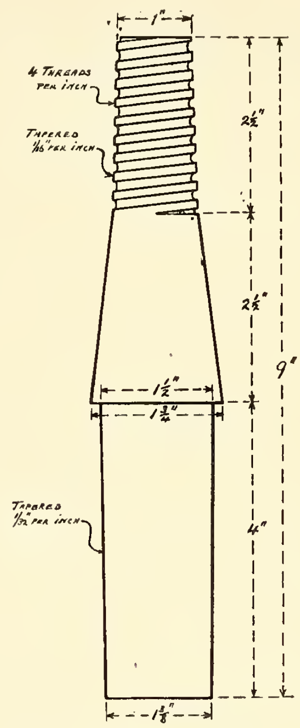


Fig. 3.—Standard Pin.

being able to stand a side strain of 300 to 500 pounds, birch and locust being about 50 per cent. to 60 per cent. stronger. Wood pins should be made a driving fit in the cross arm, and be fastened in place with a nail.

In addition to the all-wood pin there are numerous combinations of wood tops with wood or porcelain bases, the centre being a 7-16 inch, 1-2 inch or 5-8 inch bolt. These designs will not only carry greater loads themselves without failure, being able to carry a side strain averaging 3,000 pounds before bending, but also have the advantage of weakening the cross arm much less. The porcelain base, when employed, is for the purpose of throwing any arc away from the pin, and thus increasing the breakdown potential. Besides these combinations there are a great variety of all-metal pins, but they are seldom employed except on metal tower work or on extra high potentials. Some authorities, though, claim that wood pins are unsuitable for use with pressures materially higher than 20,000 volts, on account of their tendency to carbonize under the static discharge which is always present on such potentials. For the apex wire on single circuit lines a ridge iron makes far better construction than either a pin in the top of the pole or a struction than either a pin in the top of the top or a wooden side block.

Insulators.

The insulator in most general use in this country, comprising as it probably does 90 to 95 per cent. of those in service, is the well-known double grooved double petticoat glass type, about three inches in diameter, this being suitable for potentials up to 3,500 volts. For the higher potentials of 6,600 and

10,000 or 12,000 volts practice is about equally divided between a triple petticoat glass form, about 5 to 5 1-2 inches in diameter, and a somewhat smaller double petticoat type made of porcelain, with a tendency towards the latter. For voltages higher than these porcelain is now used almost exclusively, though at first there was a tendency to use glass on lines operating as high as 20,000 volts. The only advantage that can be claimed for it is that of lower cost, it being inferior in both mechanical and electrical strengths, but as the insulators form such a very small fraction of the total cost of the line, while at the same time being one of the most vital points, it is but poor practice to economize on them, the result of such a policy inevitably being that the reliability of the whole plant is lowered very materially, while the saving on the total cost is almost imperceptible. One piece porcelain insulators with two petticoats are satisfactory for potentials not exceeding 12,000 volts; for higher pressures the two, three or four piece forms are desirable, depending upon the actual voltage. For telephone work a small glass insulator, commonly called the pony form, is satisfactory if the line is not on the same poles with a high potential circuit. If the two circuits be run together it is desirable to equip the telephone line with the regular double petticoat 3,500 volt form.

Porcelain insulators are usually rated with reference to the number of petticoats and their shape, the over-all dimensions, and the arcing distance. This latter is the sum of the shortest distances from the

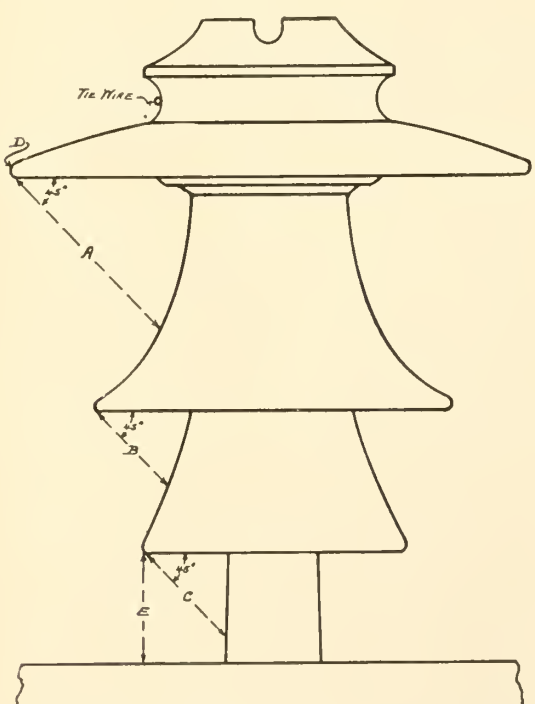


Fig. 4.—Insulator Arcing Distance and Mounting.

edge of one petticoat to the nearest point on the next part of the insulator, together with that from the edge of the lowest petticoat to the pin, the measurements all being made along lines running 45 degrees below the horizontal. This will be more easily understood from Fig. 4, in which A+B+C is the arcing distance, all the various surface distances, such for instance as that between the tie wire and D, being neglected, as in a rain these have little or no insulating value. The length of the pin should be so arranged so as to make dimension E, the height of the lower petticoat from the cross arm, substantially equal to C. Experience indicates that porcelain insulators of ordinary design will arc over at about 10,000 volts per inch, which means that the one shown in the illustration, assuming that A+B+C totals to 9 inches, would allow an arc to pass over it at about 90,000 volts. As the allowable line potential is generally figured as 60 per cent. to 75 per cent. of the arcing voltage, we have 55,000 to 65,000 volts as a fair line pressure for the insulator in question. Unusually adverse conditions, such as an extraordinary amount of dust, the presence of sulphur smoke, salt, fog, etc., will reduce this figure considerably, in extreme cases cutting it down as much as 50 per cent. Contrary to the usual understanding, rain is not hard to contend with, in fact being very welcome at such intervals as will insure that the insulators are kept free from any heavy coating of dust. Insulators are usually tested under a rose nozzle delivering a precipitation of 3-4 inches of water per minute, at an angle of 45 degrees. Good porcelain will stand about 33,000 volts for every 1-8 inch of thickness before it will puncture.

In addition to glass and porcelain, a composition insulator has not long since been placed on the market under the trade name of Electrose. It is considerably dearer than porcelain, but as an offset to this it is claimed to be practically unbreakable. Comparatively little is known of it at present, the only line in this part of the country which is employing any being one of the Niagara transmissions.

Conductors.

For the conductors themselves copper still remains the favorite, though aluminum, in the States at least, is now being employed rather more freely. For transmission lines bare solid wire is used almost exclusively in wood pole work, but for the extra long spans permissible with steel towers cable is more desirable. The smallest permissible gauge in any case is No. 8 B & S, in fact in many plants nothing less than No. 6 is allowed. The standard insluation for all ordinary voltage lines passing through cities or other incorporated districts is double braided weatherproof, though a triple braiding is required where the Underwriters have jurisdiction. Municipal authorities sometimes call for high potential circuits within their boundaries to be insulated with rubber, or to be in the form of a triple conductor cable. It goes without saying that in copper work all joints should be soldered after twisting, and then insulated to the same standard as the line itself, if that consist of covered wire. Aluminum, as is well known, can be soldered only with the greatest difficulty, in view of which twisting only is generally considered satisfactory if splicing sleeves be used.

The above refers of course to light and power conductors. For telephone work No. 10 and No. 12 iron wire for local and long distance or transmission work respectively, with No. 12 and No. 14 hard drawn copper as almost preferable alternatives, are the general standards.

When high potential lines are run on the same pole with telephone and telegraph circuits they should always be above the others, being the stronger of the two and thus less liable to break. Care should be taken to run all circuits systematically, a given wire

being always kept as far as possible in the same relative position. The two wires of any one circuit will have less self-induction if run alongside each other, though sometimes other considerations make it desirable to keep them apart. As a general rule the feeders should be on top, with the mains below, the transformers, if not too large, going in between the high and low voltage lines. The neutral of a three wire circuit should always be in the middle, the other two wires, and also the three conductors of a three phase line, being so placed as to be at once distinguishable by their position alone. Series circuits, as a rule being dead during the day, can conveniently be run on the pins nearest the poles.

The tree question is nearly always a vexatious and costly problem to all companies operating on public streets, because while one but seldom finds a location which is entirely free from trees, still the circuits must as far as possible be kept clear of them. Three alternatives present themselves, outside of course of a clear right of way, namely, to go over the trees, through them, or under them. The first method is expensive, and even then more or less temporary, because trees take but a comparatively short time to reach even the tallest poles. Trimming through them is also expensive, besides which it generally produces more or less opposition, nevertheless a certain amount is unavoidable in practically every line. The third alternative of running underneath is very satisfactory, but unfortunately there are but few situations where it is practicable. When perfect clearances cannot be obtained by any of these methods it is desirable to install what is known as tree wire. This is a type insulated with 3-32 inches of rubber, protected with two weatherproofed braids, the whole being reinforced with a round wooden moulding at points subject to abrasion.

All secondaries should be grounded, the connection being taken from either the neutral of a three wire 110-220 volt system, or from one side of a two wire 110 volt circuit. Great care should be taken to get to a good ground, preferably a water pipe, using say a No. 4 copper conductor. Poor grounds are far worse than nothing at all, and in part become a positive source of danger, seeing that they give a false sense of security, and in addition bring line potentials down among the street traffic.

Sag.

The question of sag is most important, involving as it does not only the appearance of the line but also its safety and reliability, seeing that both the strain on a conductor, and thereby its clearance from other lines, are both directly affected by the sag. This deflection or sage at the middle of a span is found from the formula:

$$D = \frac{L^2 \times W}{8\,T}$$

Where:

D is the Deflection in feet.

L is the Length of the span in feet.

W is the Weight of the conductor in lbs. per ft.

T is the maximum allowable Tension in lbs.

By transposing this we can find the tension resulting from any given sag from the following formula, viz.:

$$T = \frac{L^2\,W}{8\,D}$$

Soft copper wire may be considered as having a tensile strength of 35,000 pounds per square inch, that of hard drawn being about 65,000 pounds, and the maximum tension should never exceed one-quarter of these breaking strains, or in other words there should always be a factor of safety of at least 4. This requires that in soft copper lines at a temperature of 70 degrees F., a deflection of at least 21 inches be allowed in the centre of 100 foot spans, the minimum temperature being taken as —20 degrees F. All calculations must of course take account of this latter factor, because the minimum sag, and with it that maximum permissible strain which will still leave the required factor of safety, are found only at the times of lowest temperature.

The foregoing takes no account of the additional strains introduced by ice on the wire and by wind pressures. A layer of ice half an inch thick weighs from .4 to .5 pounds per foot of wire, depending upon the gauge, which in sizes below about No. 0 means doubling the weight to be carried, or in other words that the normal factor of safety is halved, if not cut lower. A wind of 50 miles per hour gives a pressure in the neighborhood of 12 pounds per square foot, which means nearly .1 pounds per linear foot on a No. 6 wire, or about one and a half times its own weight. This also goes to reduce the factor of safety, though as a wind is practically always at right angles to the line its effect is not combined directly with the other strains. The combination of half an inch of ice, with a storm of 50 or 60 miles per hour, and the minimum temperature for which the line was calculated, will bring down practically any circuit that was ever put up. Fortunately, conditions like these are but seldom met with simultaneously, but still if reliable service is to be given such factors of safety must be provided as will meet any combination likely to be encountered.

The sag in parallel conductors similarly strung, that is, supported from the same cross arm, may without objection materially exceed the spacing between conductors, since in cases like this all the wires will swing at the same time and to about the same degree. As compared with this the sags in wires which are not similarly supported, such as when two lines cross, etc., must be carefully arranged and the clearances made such that the lines can never come together, particular attention being given to the spacing between conductors and guys, and it must not be forgotten that these latter do not sag. The actual clearance between all wires not similarly supported should naturally be as much as is reasonably possible, 2 feet being probably the smallest safe distance, more if the conductor spacing is already greater. There is no legal limit as to the clearance between wires and ground, other than that the Ontario Railway Board requires that telephone lines shall be 20 feet from the crown of roads, and 25 feet above railroad crossings. It is probably good practice to put light and power wires if anything a little higher, particularly if the voltage be high, certainly in no case should they be lower. Another point to be considered is the passage room required by linemen, for which purpose the two wires next the poles should be kept at least two feet apart. With the same end in view it is usual to put the longer cross arm of two circuit transmission lines above the other one, this arrangement giving the

most room for anybody working on one circuit while the other is alive.

GUYING AND BRACING.

Substantial and liberal guying and bracing are of course prime requisites of a good pole line. The most serviceable material for this purpose is 5-16 inch or 1-4 inch galvanized steel cable, No. 4 or No. 6 solid wire sometimes being substituted, but it is not nearly so satisfactory. Strain insulators should be inserted in all guys about 6 feet from the pole, also at a corresponding point at the other end if the guy be attached to a building or is accessible from the ground, this second insulator being particularly necessary if the guy crosses a foreign line. It is general practice to guy to other poles or to stubs, attaching the guy about 8 feet from the ground; they should not be put on to trees, buildings, etc., except in cases of necessity. Sometimes, particularly in single phase railway construction, guy wires are grounded, but here as in all other such work too much stress cannot be laid on the necessity for getting a thorough and lasting ground.

Guys can be divided roughly into two forms, head and side guys. The first type is used at terminal poles, on steep hills, and at intervals of say one-quarter to one-half mile on level straight lines, the second, not always possible in streets, being desirable on all corners, or at any rate those where the strains are unbalanced, and on curves containing poles with more than about 10 feet offset. Both forms should preferably be attached to the poles, not the cross arms, except on corners or dead ends, though in high potential work this becomes imperative, and they should then always be attached to the pole, and below the arms. Care should be taken to get a clearance of at least 24 inches from all wires other than those carried by the pole being guyed, remembering that variations in temperature may from time to time alter your clearances very materially, because a guy wire, being always under high tension, will not sag like the conductors. All guys should be erected and tightened before the conductors are strung, if the work be done in the reverse order many poles will be pulled so far out of place that they can be got back with only the greatest difficulty, if at all, besides which the strains and sags of the line wires will be badly disturbed.

Braces and anchors are special constructions used in situations where ordinary guys would be impossible or at least undesirable. If the soil is not such as will make a suitable foundation for a brace it is necessary to make a bed of stones, or of cross timbers. Anchors can be strained from a cross log or they can be of one of the patent all-metal forms now on the market, several of which are very reliable. It is probable that on the whole these latter make the cheapest and best construction.

ARC AND INCANDESCENT LAMPS.

For the support of series arc and incandescent lamps it is desirable to avoid cross suspensions as far as possible, the most reliable device being a bracket, of which many good forms are on the market. When cross suspensions must be installed they should be 5-16 inch or 3-8 inch steel cable, insulated at both ends. Arc lamps are generally placed about 18 feet to 20 feet from the ground, incandescents about 15 feet. The leads to all swinging lamps should be stranded, not solid, and insulated with rubber, duplex conductors making the best appearance. Series circuits should not be attached to buildings, and preferably should be kept entirely distinct and separate from even the primaries. Supporting ropes, particularly if metallic, should be separated from the lamps and lines by insulators which insure a dry surface under all conditions of weather, lowering ropes car-

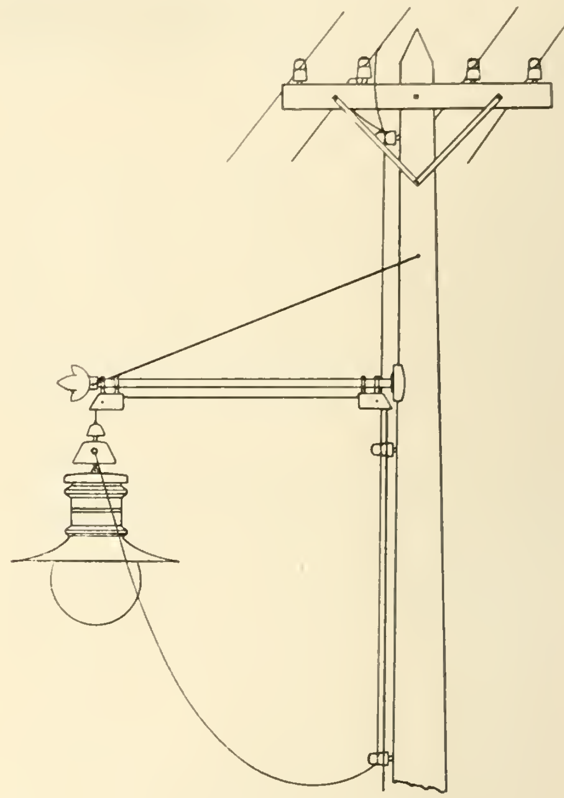


FIG. 5.—ARC LAMP SUSPENSION.

ried by the trimmer being preferable to slack at each individual lamp. Figs. 5 and 6 illustrate typical suspensions for arc and incandescent lamps respectively.

TRANSFORMERS.

Transformers weighing not over 250 to 300 pounds can be mounted at any convenient point on a cross arm, those weighing more than this, but still not exceeding about 800 pounds, can be installed on cross arms if the hangers are placed astride of the pole, the larger sizes requiring double arming. Transformers in excess of 1,300 or 1,400 pounds are rather too heavy for hanging, and have to be supported on platforms. When placed on poles they should as far as possible be located between the primary and secondary lines.

It is customary to put in primary fuses large enough for 50 per cent. overload, the single pole type being far superior to the double pole form. The secondaries are generally fused in the two outsides with pole line safety catch-holders, all neutrals being unfused. An alternative method is to omit the secondary fuses at the transformer and place them in the secondary mains about midway between transformers, in which case they are made large enough to carry only about 30 per cent. to 50 per cent. of the transformer capacity. The advantage of this method is that should trouble develop in a transformer, or in the mains which it supplies, the difficulty is automatically removed without disturbing the rest of the system. This is not true of the method employing secondary fuses at the transformer, because

then a short at any point on the mains becomes a short throughout that section, and will probably shut it all down. A similar result comes from trouble in a transformer, because the load which it has been carrying, when it comes on to those remaining after its fuses have blown, will probably create an overload sufficient to blow their fuses also. When operating three wire systems sufficiently large to require two transformers on a pole, it is advantageous to individually connect them for two wire work, with one across each side of the system, then trouble in either one will affect only that side, leaving the other half of the system in operating condition. When they are both connected three wire any difficulty in either will shut everything down.

Lightning Protection.

Lightning protection is afforded by two standard methods, namely, by lightning arresters and by wires run along and above the circuits and grounded at frequent intervals. This latter method is used only on transmission lines, it being unnecessary on distributing systems, as lightning arresters alone are usually found quite sufficient. This is due probably to the fact that they can be used somewhat more liberally, on account of the generally lower voltages, besides

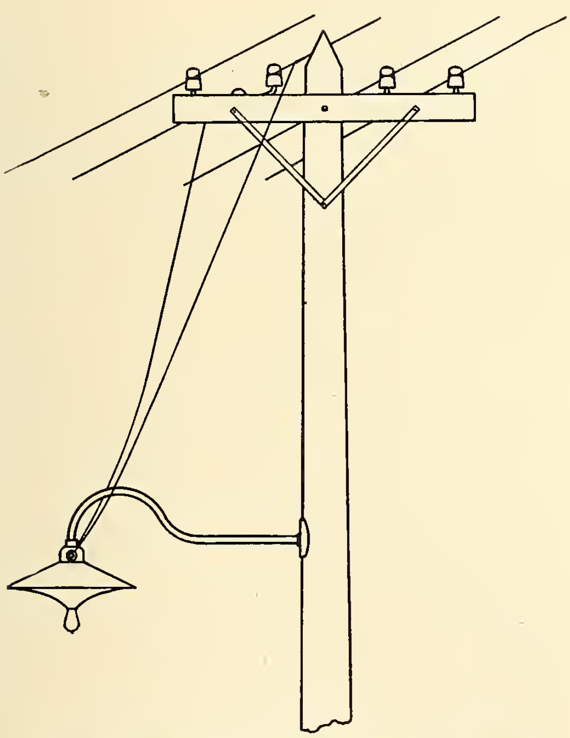


Fig. 6.—Series Incandescent Lamp Bracket.

which the increased facilities for inspection render it more likely that they will be kept in good condition. Further, the number and character of the strokes encountered by distributing circuits are probably quite different from those which attack transmissions. When grounded wires are used they should be run at the top of the pole and supported on small insulators or some similar fastening, the use of staples being objectionable in that they tend to break the wire very quickly. Care should be taken to use nothing but substantial material, No. 6 steel wire for moderate spans, and 1-4 inch or larger steel cables for stretches longer than say 150 feet, making the best construction. Ordinary barb wire is utterly unsuitable, being entirely too weak, besides which the barbs make it exceedingly difficult to handle, without having any compensating advantages.

Besides the above two methods of lightning protection there are two others which are being watched to-day with considerable interest, namely, the application of the horn arrester to each individual insulator, and the electrolytic arrester. The horn arrester itself is not new, but the mounting of one at every insulator certainly is, and as the work can be done at comparatively little cost, it is an application which is likely to come into fairly general use if the present experiments prove successful. The electroyltic type consists of a vessel containing an electroylte, with two electrodes dipping into it, or separated by a very small air gap, with or without a small series resistance. It is suitable for alternating work only, and appears to be a form which is going to give very fine results, though so far it is largely in the experimental stage.

Grounds are made at every fourth or fifth pole, here again it being most necessary to get a good connection. This, of course, is much harder to obtain in transmission lines than in distributing systems, rails and water pipes, which are naturally the first points to be sought for, being as a rule conspicuous by their absence. Failing these, copper or iron plates, not less than two feet square, and buried in a coke bed twelve inches deep, pipes driven not less than 8 feet into the ground, or 10 to 15 feet of wire coiled about the base of the pole, are all standard alternatives. The connection between the overhead wire and the ground should be substantial, say a No. 4 galvanized iron wire, run as straight as possible, and soldered to the upper end of the pipe, if one be used.

Lightning arresters are installed in all generating stations, preferably on every outgoing wire, and in addition should be placed at intervals on the lines of all but the most compact distributing systems. It is difficult to give any general rule governing their location, but experience shows that they are desirable at centres of distribution, and at other points where there is a large group of apparatus, besides which they are frequently necessary at the ends of circuits and at extra high or exposed points on the lines, as lightning often makes itself repeatedly felt at such locations.

It should be noted that, as lightning arresters act not only in getting rid of charges between lines and earth, but also of those between line and line, they are a very necessary addition to even the best ground wire equipment. This is particularly true of the higher voltage lines, in which not only are abnormal potentials more likely to be found, but also where the factors of safety are as a general rule somewhat less than in lower voltage installations.

Opinion seems to be divided as to the usefulness of choke coils, but as they are but a comparatively inexpensive addition, and may in some cases be the means of saving a shut down, it would seem only good judgment to put them in. About 50 feet of any wire large enough to carry the current, and coiled in a spiral of any convenient diameter, makes a satisfactory coil, though the insulating supports required by high voltages frequently make the completed article of quite large dimensions.

TRANSPOSITIONS.

As a general rule the unbalanced voltages resulting from the absence of transpositions are far less trouble than is generally supposed, in motor service being to all intents and purposes entirely negligible, and for lighting work being capable of counterbalancing, either by operating all lights off one phase, or else by feeder regulators. In view of this it is probably the better practice to omit them if one be in doubt, as they are at the best but an eyesore and a source of weakness, besides which they can be put in at any time if ultimately found desirable.

No settled practice can be said to exist as to the best method of transposing a line, though in the majority of cases longer cross arms are employed, in order to get the necessary clearance at the point where the wires cross, two conductors being changed at a time, the operation occupying two or three poles. The spacings vary anywhere from two to ten miles between transpositions, of which there are generally three per circuit.

When considering telephone lines the case is different, it bery very necessary to transpose those which run on the same poles as light and power circuits, otherwise the induced voltages in the telephone lines will be so unbalanced as to render satisfactory talking almost impossible. Transpositions are consequently put in about every fifth pole, special insulators, made for the purpose, allowing the change to be accomplished at the one pole. When the telephone line is run on side blocks instead of cross arms, as is occasionally done, though it does not make as good construction, the transpositions are frequently made by putting the two blocks alternately one above the other, the wires crossing from side to side between every two poles. The telephone and transmission circuits should be about five feet apart for potentials not materially exceeding 35,000 volts. For the higher pressures of 50,000 and 60,00 volts it is usual to run them on separate pole lines.

The foregoing covers only the main and standard points in wood pole line construction, as obviously there are innumerable details which cannot be touched upon in the space available, besides this almost every line presents some peculiar conditions, due to local surroundings, which can be met only by special designs on the part of either the manufacturer or else the foreman in charge. The line, perhaps more than any other part of the system, offers both temptation and opportunity for cheap and unreliable construction, but here, as in every other part of the plant, the best is none too good. Perhaps this principle should be emphasized even more by saying that the line should always be of the best, both in materials and workmanship, even if this is accomplished at the cost of some curtailment on other parts of the system. That this is a good and proper policy will surely be granted when you consider that the line has usually to be in service day in and day out for months at a time, that it nearly always carries potentials which are dangerous to life and property if unconfined, and that it is constantly exposed to the attacks of the elements, all this frequently combined with insufficient inspection. As a natural result you must expect frequent interruptions to the service, to say nothing of accidents, unless the construction be of the best. These frequent interruptions, perhaps more than anything else, tend to discredit electric light and power, making them not only commercial impossibilities but nuisances into the bargain. On the other hand a good and reliable electric service is a boon to every community, and will bring its sure and certain reward to those who supply it. Let us never forget, though, that this happy state of affairs cannot be brought to pass without due attention to all parts of the system, among which the overhead line stands as by no means the least important.

LOSS OF HEAT IN ESCAPING GASES.

No greater waste occurs in modern steam boiler practice than that which is inherent in the employment of a chimney for the production of draft, namely, the loss of heat in the escaping gases. As the chimney depends for its action upon the maintainance of a temperature difference between the internal gases and the external air, it is manifest that, with a chimney, this waste can never be eliminated. It may be palliated, it is true, by the building of higher chimneys, so that the same intensity of draft may be obtained with a lower stack temperature. But such means of providing for the utilization of the otherwise waste heat is expensive. For instance, if, with an external temperature of 60 degrees and an internal temperature of 500 degrees, sufficient intensity of draft is produced by a chimney 100 feet high, it will require a height of 175 feet to produce the same draft when the temperature of the gases is reduced to 250 degrees. In addition, the means provided for extracting this heat will increase the resistance, and provision for overcoming the same will have to be made by greater chimney height.

In the case of a fan, however, the power expended as measured in heat units necessary to produce the same results, may, under ordinary conditions, be only about one seventy-fifth of that necessary with a chimney. In other words, the fan renders available for utilization practically all of the heat wasted by the chimney while it possesses the further advantage of readily creating the additional draft required when heat-abstracting devices are introduced.

Donkin and Kennedy, in seventeen independent boiler tests, found the heat lost up the stack when no economizer is used, to range between 9.4 per cent and 31.8 per cent of the total heat of combustion. As it is not practicable to cool the gases to atmospheric temperature, it is evidently impossible to utilize all the heat, but the ordinary economizer should, with mechanical draft, show a saving of between ten and twenty per cent.

The bucking and snorting refusal to start of the gas engine is, states "Power and Transmission," often due to moisture in the cylinder preventing regular ignition till dried by the heat of several explosions. The difficulty may be obviated by shutting off the cooling water a few minutes before the starting of the engine and not turning it on again until after the engine begins to explode regularly when again started.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—In connecting up three wire wattmeters, is it best to have the potential coil across one side only, or should it be wired between the two outsides?

Answer.—You must, of course, connect the meter one way or the other, according as it is built for the potential between the neutral and one of the outers, or that between the two outers. As to which is the best way to build it, you will find that in either case the meter does not record accurately when the two voltages are unbalanced, so that as far as correct reading is concerned there is practically no choice. About the only point that is affected, as far as the operating man is concerned, is the wiring. If the meter be wound with a potential coil suitable for connecting across the two outers this can be wired up inside the meter, as both sides of the circuit have to come into the latter, and so you save any external potential taps. For this reason, namely, that it somewhat simplifies the wiring, winding the potential coil for the voltage between the outers is generally more popular than the other way.

Question No. 2.—Can I ring an ordinary house bell off a lighting circuit? Ours is alternating and 110 volts.

Answer.—Yes, this can be done, either by getting a small low voltage transformer, made for the purpose, or else you can get the same result in another way, namely, by putting the bell in shunt with a small resistance. This should consist of about 20 to 25 feet of No. 20 or No. 24 German silver wire, cotton covered, coiled up into any convenient form, the bell being connected in multiple with it, and the combination being wired in series with a 16 candle power lamp across the house circuit. You must remember, though, that you are dealing with that voltage and not with a 3 volt battery circuit, consequently you must do all your wiring just the same as for ordinary lights, mount the bell upon insulators, and use porcelain push buttons with a good long break. The ordinary bell wiring and wood push buttons will not do. You may have to vary the length of the German silver wire a little bit, or perhaps even change the size of the lamp, depending upon the particular bell which you have.

Question No. 3.—A manufacturer of waterwheels (who wishes to sell to us, of course) claims that his wheel, which is 62 inches, will under a head of 7 feet produce 144 horse-power. What horse-power will such a size wheel under such a head produce?

Answer.—We would say that this rating was just about right, bearing in mind that this is the power delivered by the wheel at the shaft, and that no allowance is made for gearing losses. You will probably require a horizontal shaft, and as wheels of this character are usually set vertically, the mitre gear in between the two shafts must be allowed for. This will consume at least 10 per cent. of the wheel power, leaving say 130 horse-power net for delivery to your belting, or whatever your load may consist of.

Question No. 4.—Is it possible to start induction motors from the switchboard, which is in the engine room, by leaving the switches in and starting the dynamos? Can it be done with direct current motors?

Answer.—Yes, this can be done if you have a separate exciter for your alternator, and for the direct current machine if the direct current motors are shunt wound. The procedure is simply to leave all the switches closed, just as if the plant were running, and then, the alternator being excited, to start your main engines or waterwheels, the motors will come up to speed with even less disturbance than if started in the regular way. The procedure is just the same with direct current shunt wound motors, but if these be series wound the procedure is even more simple, in that you do not need separate excitation for your generator fields. All you have to do is to close the switches and start up your generator, the motors will come up to speed as the former builds up its field.

Question No. 5.—What is the object of the field break-down switch on rotary converters, and how does it work?

Answer.—Breakdown switches are put into rotary converter shunt fields for the purpose both of safety to the machine, and also to the operators, when starting it from the a. c. side. When the alternating potential is thrown on to the armature there is a transformer action between it and the field, which results in quite a high potential being generated in the shunt field windings. If these latter be left connected all in series, which is their normal condition, the sum of the potentials generated in each may be sufficient to cause a ground or some other burnout somewhere round the machine, or to give an attendant a bad shock should he happen to touch the circuit just at that instant. The breakdown switch simply cuts the shunt field circuit into say four parts, when it is opened, so that the maximum potential is only one-quarter of what it would be were the windings left connected all in series. The transformer effect grows less and less as the armature comes up to speed.

Question No. 6.—I saw the result of a transformer test the other day, in which it was said that the voltage only dropped 1 1-2 per cent. when the load was put on, the manufacturers then going on to say that this showed a regulation of 1 1-2 per cent. Is this correct?

Answer.—According to the A. I. E. E. Standardization Rules, full load, and not no load, is considered the normal basis, as that is the important condition and the one under which nearly all guarantees have to be performed. In view of this the proper way to express the regulation of a transformer is to take the rise in the secondary voltage when full load is taken off, the applied primary voltage remaining constant, the percentage this rise bears to the full load secondary voltage being the percent. regulation. You will see from the above that the true regulation is poorer, though of course by a very small amount, than is claimed for the transformer.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Heating Goods. Now that summer is here the advantage of electric household devices become more and more apparent, so that it behooves every operating man who has a day circuit to see if he cannot increase his earnings by means of these materials. The greater number of them will connect directly into any ordinary socket, and thus can be installed by the purchaser without either delay or extra expense. The most common articles are perhaps curling iron heaters, chafing dishes, sewing machine motors, and last but not least, because it is really the most useful and popular of all, flat irons. In fact this latter is the great big staple device, and the one which should be offered as the thin edge of the wedge. Experience has demonstrated time and again that once introduced in a household they are firmly established, the ease with which they can be quickly brought to operating condition in any room in the house in which there is a socket, combined with the absence of dirt, smoke and heat, making them highly valued. From the standpoint of the station they are equally desirable, because in the first place they create a load, and secondly because that load comes on during the day time, when most of the lighting is off, therefore it is doubly welcome. At average rates a flat iron alone will earn about $10 per year, if not more, which is business that can by no means be despised. Every little helps in central stations earnings as in everything else, and in the States this has been recognized to such an extent that many of the larger companies have organized departments devoted exclusively to heating goods. Why should some of our Canadian organizations not do likewise?

The C.E.A. Convention and the Electrical Exhibition. The forthcoming convention of the Canadian Electrical Association, which opens in Montreal on September 11th next, will present two distinct innovations, the effects of which will naturally be watched with great interest. We refer, of course, to the facts that for the first time in the history of the Association there will be available for the inspection of the delegates a large and comprehensive collection of electrical apparatus and supplies, and that the present session marks a radical change from the usual spring meeting. At no previous convention have there been any very concerted steps on the part of the manufacturers to make an exhibit, any material shown being confined to such apparatus, necessarily small, as could conveniently be placed in a reception room, in view of which the present opportunity to see a large and varied assortment of electrical material will be all the more welcome. The various kindred gatherings on the other side of the line, such as the National Electric Light Association, the American Street Railway Association, etc., have always had very large exhibits in connection with their meetings, and as these have always proved a most attractive and valuable feature of their programme, it is confidently expected that the same will be the case in Montreal. It is, of course, always incumbent upon operating men to attend the convention, as far as it is possible for them to be there; further it is the duty of their respective companies to see that they be given every facility to do so, be-

cause no man can be expected to produce good results if kept steadily in the one groove, year in and year out, without a chance to see and hear what other men are doing. Therefore, make a special point of attending if you possibly can, and see that your friends do likewise. The Maritime Electrical Association is coming up in a body, so that a good representation from the east is assured; let the west be equally active. Another point, once you are there be sure and attend all the meetings, and attend on time, as ample opportunity will be given for viewing the Exhibition and for sight-seeing without neglecting the business proper. The papers to be given this year will doubtless be of great interest, as they have always been in the past, but they lose a large part of their value unless they be well attended and fully discussed. As a matter of fact, the discussion is always one of the most valuable features of any gathering, and to that end it is hoped that every one will feel it both his privilege and his duty to take some part therein. The Exhibition, which will be open from the 2nd to the 14th of September, is to be held in the Drill Hall on Craig street. The convention will be held on the 11th, 12th and 13th, in the rooms of the Canadian Society of Civil Engineers, who have again been kind enough to extend the courtesies of their building to the Association.

New Standardization Rules.

The American Institute of Electrical Engineers, familiarly known as the A. I. E. E., or more simply as the Institute, stands in very much the same relation to the electrical profession as the Law Society or the Medical Council do to their respective fields, the main difference perhaps being their varying legal standings. Notwithstanding, though, that the Institute is unable to enforce its rulings except as a matter of professional practice, it still is doing most valuable work for the whole electrical profession by laying down rules of practice, such, for instance, as the Code of Ethics, which we published last month, and by establishing definite classes of machinery, uniform specifications and tests, and standard voltages and frequencies, etc., etc., under the heading of the Standardization Rules of the "A. I. E. E." These were first issued in 1899, being revised in 1902, this last edition having been in force up till the appearance of the new recommendations brought before the Institute convention held in June last. This last issue is apparently very complete, containing as it does 360 sections as against some 90 odd in the first report of the committee, and a little over 100 in the second. The increase is doubtless emblematic of the growth of the electrical industry, and as such must be most gratifying to all concerned. An entirely new section, and one that in that way plainly marks the rise of the illuminating engineer, is that devoted to photometry and lamps. This contains many very necessary rulings, particularly, for instance, that relating to the comparison of incandescent lamps on the basis of total light emitted, and not by measuring the illumination from some one point only, which point is generally that most favorable to the particular lamp under test. Then the standard of candle power is defined, the basis being the Hefner unit, which is the one used in all the calculations of the Reichsanstalt, the German Bureau of Standards, probably the world's greatest authority on light. The clause on the illuminating power of street lamps is also most valuable, because the present rating is bound to become more or less of a hindrance as the new high efficiency lamps come more and more to the front. It would be a great pity if the battle which was fought to get rid of the 2,000 candle power claim had to be waged all over again with respect to the present practice of naming the watts consumption of the lamp, and so the present action of the committee is all the more welcome. Another most significant change is that relating to standard high tension voltages. The original rules contained nothing on this point, but the 1902 revision named receiving potentials of 6,000 volts, 10,000, 20,000, etc., up to 60,000 volts as a maximum. The present report now names as standard the generated potential, viz., 6,600, 11,000 22,000, etc., up to and including 88,000 volts, a material rise from the previous maximum of 60,000, and one which in that way very distinctly marks the progress which has been made in high tension transmission. It is also interesting to note the reiterated recommendation that 2,200 volts be considered the standard potential for primary distribution circuits, with step-down transformer ratios of 10 and 20 to 1. It is a pity that transformer manufacturers do not unite on this as a common basis, and eliminate the many odd ratings and ratios which are unfortunately anything but rare. The insulation tests for all high tension material for circuits above 2,500 volts is specified to be double that of the rated potential of the apparatus. This is a fairly large increase over the previous ruling, which was that such tests should be made at voltages 50 per cent. above that of the circuit, but it will give a factor of safety that is doubtless none too large when the increasing use of higher and higher potentials is considered. For lower voltages different tests are detailed varying with the actual potential and the kilowatt capacity, though the figure on transformers remains unchanged, viz., 10,000 volts between primary and secondary and primary and core. As further illustrating the progress being made in alternating work it is most satisfactory to note that 125 and 133 cycles have been dropped from the list of standards, 25 and 60 being the only two remaining. These may possibly be added to in the next few years by the requirements of single phase traction, for which work 15 cycles may prove the most desirable; outside of this one addition it is unlikely that we will ever be hampered by any increases to the above two periodicities.

Another new section is the one bearing on the rating of street railway motors. This consists to quite an extent of the methods for rating and testing which have been practically standardized by the manufacturing companies, but its issue in the present form gives it an authoritative basis which has heretofore been lacking. The report closes with a table of sparking distances now running up to 300,000 volts, just exactly double the limit of that in the 1902 issue, together with a very complete set of temperature formulae and resistance co-efficients for copper wire. The complete publication of course forms a most valuable addition to electrical literature, and one that will doubtless be a guide to innumerable engineers for some time to come. The Institute in general, and the committee in particular, are to be congratulated upon it.

Electric Power Plant at the Coal Mines

On July 31st the Maritime Coal, Railway & Power Company, Limited, put into operation their power plant, transmission line and sub-station at Chignecto and Amherst, N.S. The plant was started by Lieutenant-Governor Fraser of Nova Scotia, in the presence of many distinguished guests.

Several brief descriptions of this plant have appeared from time to time in the daily press, but a more detailed description may be of interest to the readers of The Canadian Electrical News.

The power plant is located about 300 feet from the bankhead of the company's coal mine at Chignecto, N.S. The coal is raised in the usual manner to the bankhead, where it is screened, and the refuse and culm from the screens are carried by a conveyer into the power house. The power house is a brick building, about 75 feet by 50 feet long, divided longitudinally by a brick wall into a boiler room and an engine room. In the boiler room are located at present four Robb return tubular boilers, each having a rated capacity of 150 boiler horse-power. At one end of the boiler room are located the boiler feed pumps and a Cochrane open heater. The boilers are erected in two banks of two boilers each. Between these two boilers is situated the induced draft apparatus, which consists of two Canada Buffalo Forge Company blowers and blower engines. Either one of these blowers is sufficient to produce two inch draft in the uptake, with all four boilers in operation.

Maritime Coal, Railway & Power Company, Chignecto, N. S.—Panoramic View.

A steel stack, 25 feet high, stands on the top of the blowers, and projects through the roof of the power house. Automatic stokers, of the Jones underfeed type, have been attached to the boilers.

The coal is carried by a conveyer to bins located above and in front of the boiler, and from these bins is spouted direct into the hoppers of the underfeed stokers. Owing to the fact that the coal is of a very low grade and contains much foreign material, the grate area of the boilers was made considerably larger than the standard practice.

At a distance of about 1,000 feet from the power house the company placed a dam across a narrow gully, and have made an artificial pond, about 1,000 feet long by 600 feet wide, with water at an average depth of 10 feet. This water is conveyed by gravity into a pit located under one end of the boiler room, from which the feed water and cooling water for the condenser are taken. The discharge from the condenser flows back into the pond.

The boilers are designed for 150 pounds pressure, and the steam piping is so arranged that any two boilers can be used to supply steam to the engine room. Steam is also supplied to a steam hoisting engine in the bankhead.

The engine room is about 30 feet wide, and parallel to the boiler room, as previously stated. The first unit which was put in operation consisted of a vertical high speed cross compound engine, built by the Robb Engineering Company, at Amherst, N.S., directly connected to a 500 kw. 11,000 volt generator, built by the Canadian Westinghouse Company, of Hamilton, Ont. The engine is interesting in that it is the largest high speed unit that has ever been built in Canada. The engine has a rated capacity of 750 horse-power, 150 pounds pressure, and 26 inches of vacuum. It is of the cross compound type, and operates at 300 revolutions per minute. The generator rotor is pressed on the engine shaft, and the whole machine presents a very compact and substantial appearance. On the outside end of the generator shaft is mounted a 125 volt exciter, for exciting the generator fields.

At the end of the engine room is placed a switchboard, which consists of a generator panel containing an 11,000 volt oil switch, with the usual meters for measuring the output of the generator. This panel is provided with a synchronizing equipment, so that when other machines are installed it will only be necessary to duplicate the present equipment. The outgoing line is provided with a set of high voltage fuse switches, and the whole equipment is protected by a set of low equivalent lightning arresters and standard choke coils.

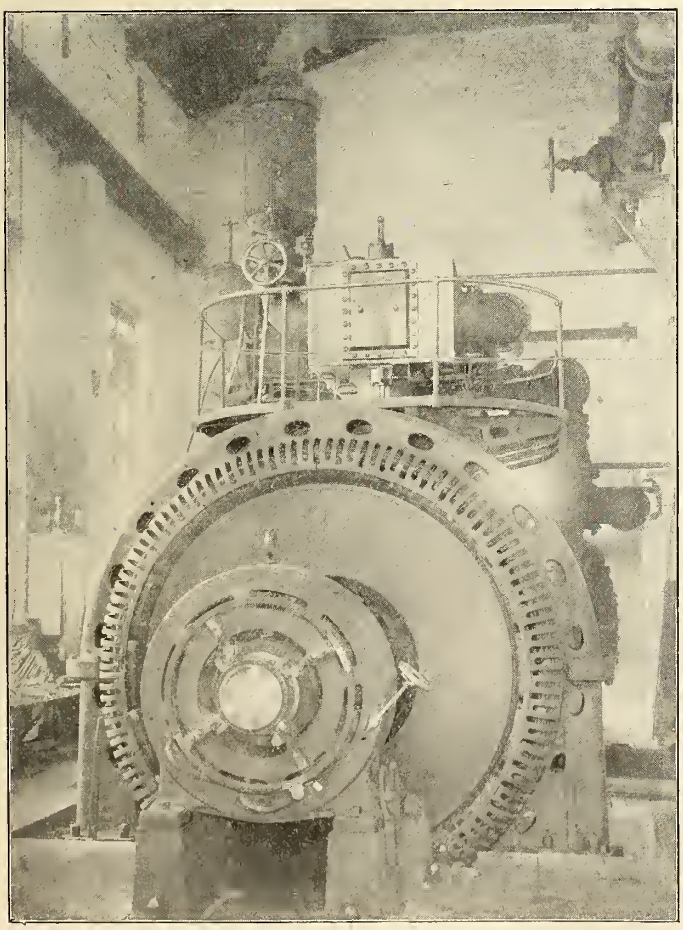
From the power house at Chignecto to the substation at Amherst, N.S., a distance of 6 1-2 miles, a transmission line is built. The poles are spaced 125 feet apart, and are in general 30 feet long. No. 4 B. & S. gauge copper wire is used, with 15,000 volt glass insulators. The pole line has been designed so that a second set of three wires can be placed on the same poles. There are several long spans in this transmission line, particularly where some of the tidal

rivers are crossed. In these places two poles have been set close together, and steel rope 3-8 inches in diameter has been used. The poles have been double fixtures, having four insulators at each end of these long spans. There are several of these spans, varying in length from 400 feet to 700 feet.

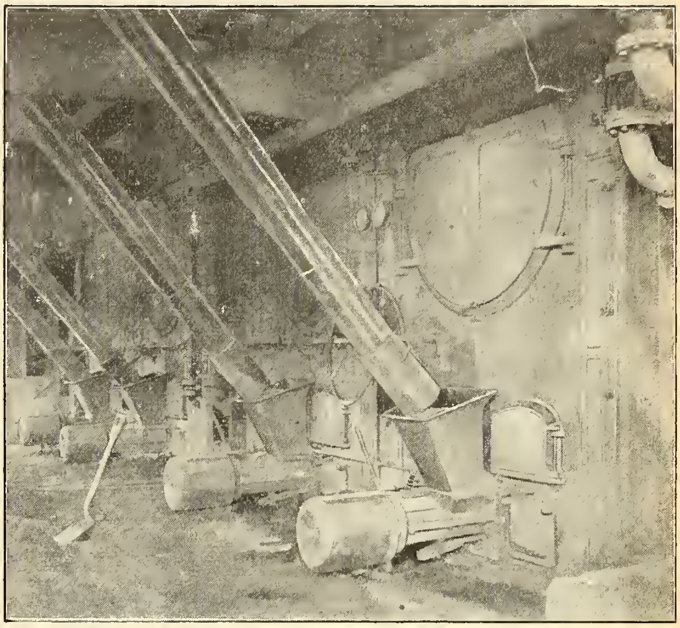
At Amherst, N.S., a sub-station has been built, consisting of a two storey brick building, 12 feet square inside. On the upper floor are placed three 150 kw. self-cooling transformers, with a ratio of 10,000 to 2,400. On the upper floor are also placed high tension fuse switches and low equivalent lightning arresters. On the lower floor is placed the 2,000 volt oil circuit breaker. Special attention was given to the design of the building to see that the upper floor containing the transformers should be properly ventilated.

From this sub-station 22,000 volt lines are taken to various industries in the town of Amherst. The Rhodes, Curry Company, Limited, have installed 300 horse-power of electric motors, and expect to largely increase this amount. The Robb Engineering Company are at present installing 100 horse-power of electric motors, and various other industries in the city of Amherst are being connected to the lines of the Maritime Coal, Railway & Power Company.

The president of the Maritime Coal, Railway & Power Company is the Honorable William Mitchell, Senator from Wellington district. The general manager, who has had charge of the works, is Mr. David Mitchell, of Chignecto, N.S. The consulting engineer is Mr. Julian C. Smith, general superintendent of the Shawinigan Water & Power Company, Montreal. Associated with Mr. Smith was Mr. Phillip Freeman, the well-known steam engineer of Halifax, N.S. These gentlemen were represented on the ground by Mr. Alex. McKee and Mr. Forest Mitchell, who had charge of the electrical and mechanical departments of the plant respectively.



Maritime Coal, Railway & Power Company—View of Generator.



Maritime Coal, Railway & Power Company—View of Boilers and Tubes for Conveying Fuel by Gravitation.

TESTER FOR TROLLEY WIRE SUPPORTS.

A tester for trolley wire supports is in use in England. It is used to detect leakage from the supported wires through to ground. The regulations of the British Board of Trade specify that each insulator supporting overhead conductors for electric railways shall be tested not less often than once a month, defective insulators being immediately removed and efficient ones substituted.

Owing to the fact that two instruments are in use in series at each testing point, the daily test of the entire line from the central station does not give sufficient means for detecting faults in the overhead insulation. It would be a tedious proposition to test each insulator separately with a pole and contact, or from a tower wagon.

The tester in question has been designed for application to the trolley pole of a testing car, and affords a rapid means of detecting faulty insulators. It consists of a light aluminum frame which is clamped at the top of the trolley pole and carries a wooden cross arm pivoted at the centre. At each end of this cross arm is a light bow or spring, and as the wheel passes under the span wire each of these springs makes momentary rubbing contact against the underside of the span wire. There is a device which operates automatically to keep the crossbar always at right angles to the trolley wire, regardless of the position of the trolley pole.

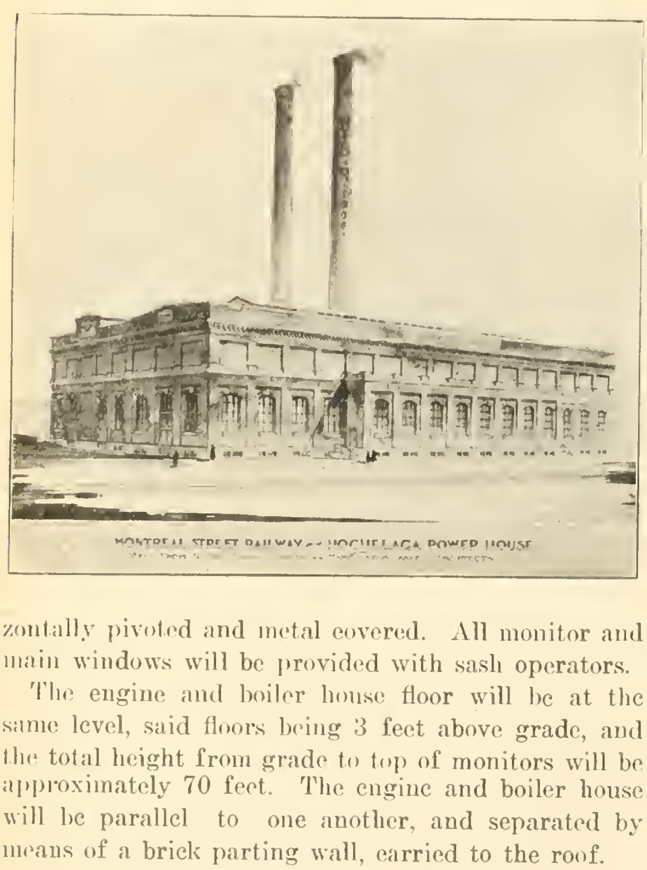
In operation the device is used in connection with a moving coil voltmeter sealed to 600 volts. It will be readily understood how the connections may be arranged so that when a faulty insulator is struck and the span wire found to be electrified, the voltmeter will show a deflection at the instant of contact. The sensitiveness of the voltmeter may be increased by pressing a key wired for that purpose, and the meter is also arranged with a direct reading insulation scale with a range of 10 megohms.

During the test the car is run at about seven miles per hour, so that it requires but a short time to test the overhead insulation of the entire system.—Engineering News.

The Hochelaga Power House of the Montreal Street Railway

The new Hochelaga power house of the Montreal Street Railway, now in course of construction, will be of fireproof construction throughout, consisting of structural steel frame, brick walls, cinder concrete roof and metal window and door frames. The floor construction will be of concrete arches, mounted on steel floor beams.

The present building will be 180 feet long, designed in 10 bays of 18 feet each. The width of the engine house between columns will be 57 feet 8 inches, and the width of the boiler house between columns will be 85 feet 8 inches. The height of both engine and boiler house from floor to bottom of truss will be 51 feet 6 inches, there being a 15 foot basement under boiler room floor and a 14 foot basement under engine room floor. Both engine and boiler house trusses will be provided with monitors, the monitor sashes being horizontally pivoted and metal covered. All monitor and main windows will be provided with sash operators.



The engine and boiler house floor will be at the same level, said floors being 3 feet above grade, and the total height from grade to top of monitors will be approximately 70 feet. The engine and boiler house will be parallel to one another, and separated by means of a brick parting wall, carried to the roof.

Chimneys, which will be located in the boiler house, will be so located that they will be in the centre of the ultimate length of power house, which when completed will consist of 16 bays of 18 feet each, making a total length from out to out of walls of 294 feet. The maximum distances from out to out of walls across engine and boiler house will be 153 feet.

Boiler House.

The present installation of boilers will consist of five batteries of Babcock & Wilcox boilers, each battery having a rated horse-power of 1,050. These boilers will be arranged in two parallel rows, facing each other, and to one side of the centre line of chimneys, there being space for an additional battery of boilers, so that the present boiler house will ultimately contain twelve boilers, aggregating 6,300 rated horse-power. Boilers will be equipped with super-heaters and chain grates.

Immediately over the boilers will be installed two sets of economizers, each set containing 1,200 tubes. Each set will consist of two economizers arranged side by side, each economizer being ten tubes wide. The steel flue for conveying the gases of combustion to the chimney will be so arranged that the gases can be passed through economizer or by-passed around same, directly to chimney. The three batteries of boilers on one side of boiler house will work as a unit with one 1,200 tube economizer.

One chimney is being installed at present, said chimney being 13 feet in diameter at the top and 225 feet above boiler room floor, and being of sufficient size to carry off the waste products of combustion from six batteries of boilers, aggregating 6,300 rated horse-power. The chimney will have a brick pedestal, 65 feet high, on which will be mounted a cylindrical shaft, constructed of radial brick. The chimney is of the Custodis type, and will be provided with both internal and exterior ladders, baffle wall and lightning conductor.

The steel flue for three batteries of boilers will be erected on the economizer floor and parallel with same, and will be connected to each boiler by means of a rectangular steel up-take. All up-takes will be provided with dampers and damper regulators, and the economizer and main flue with dampers for the purpose of controlling the gases to and from economizer. The economizer will be of the Green type.

Ample space has been provided around the boilers, the distance between the opposite boilers will be 22 feet. The aisles between boilers are 6 feet 2 inches wide, and the aisle in the rear of boilers 8 feet to 9 feet wide. The boiler walls will be erected on concrete foundations, extending to basement floor, which floor will be 15 feet below boiler room floor. Under each boiler furnace will be installed ash hoppers for the purpose of storing and feeding the ashes to ash cars.

The boiler house will be provided with coal and ash handling machinery, said apparatus being of the Babcock & Wilcox type as manufactured in Glasgow. The coal-receiving hopper and coal crusher will be placed in a pit, just outside the end wall of boiler house and immediately under railroad tracks. The coal will be elevated from this point to overhead coal bunkers, located immediately over the centre aisle between boilers. These bunkers will be constructed of steel and concrete and will have a capacity of fourteen tons per running foot. The ashes will be elevated by this same conveyor to a large steel and concrete lined ash hopper, located at the end of boiler house, and will be dumped by means of chutes to railway cars. The conveyor will be electrically driven and the stokers, economizers, scrapers and coal crusher will be steam driven. The engine for the economizer scrapers will be direct connected to the economizer frame.

ENGINE HOUSE.

The present engine house will be sufficiently large for the installing of two 1,500 horse-power and two 3,000 horse-power vertical cross compound condensing engines. The present installation, however, will consist of two 26 inch by 54 inch by 48 inch vertical cross compound condensing engines of the MacIntosh & Seymour type, each engine direct connected to a 1,000 kilowatt generator; one generator will be of the Westinghouse type and the other of the Canadian General Electric type. The engines will operate with 150 pounds steam pressure, containing 150 degrees of superheat. The generator output will be at 550 volts.

The switchboard will be mounted on an elevated gallery, arranged along wall, central with the ultimate length of the power house. The engines will be mounted on concrete foundations, and all foundations will be provided with anchor bolt tunnels for accessibility to same. To the low pressure cylinder of each engine will be connected a barometric condenser, each condenser being a unit in itself and provided with a separate circulating and vacuum pump. The vacuum pumps will be mounted on the basement floor, adjacent to each engine, and the circulating pumps will be located in the dry well. The condenser equipment will be provided and installed by the John McDougall Caledonian Iron Works Company of Montreal and will be Worthington apparatus. The air pumps will be of the rotative dry vacuum type, the sizes being 8 inches by 16 inches by 12 inches for the small condensers, and 10 inches by 18 inches by 18 inches for the large condenser. The circulating units will be two stage centrifugal pumps, direct connected to verttical engines.

HEATERS AND FEED PUMPS.

The present installation of heaters will consist of a set of open heaters, probably of the Cochrane type, having sufficient capacity to heat the necessary feed water for six batteries of boilers, rated at 5,300 horse-power, to approximately 150 degrees when supplied with the available exhaust steam. It is to be understood in this respect that all the auxiliary machinery will be provided with 150 pounds steam, containing super-heat, and that for this reason, owing to the higher economy of auxiliaries when working with super-heated steam, it has been found necessary to install economizers in order to deliver the water to the boilers at a suitable temperature, the temperature of the feed water for several months of the year ranging from 35 to 40 degrees Fahrenheit.

The present installation will consist of two duplex outside end packed plunger pumps, having pot valves, each pump to be capable of delivering approximately 275 gallons per minute at a low piston speed.

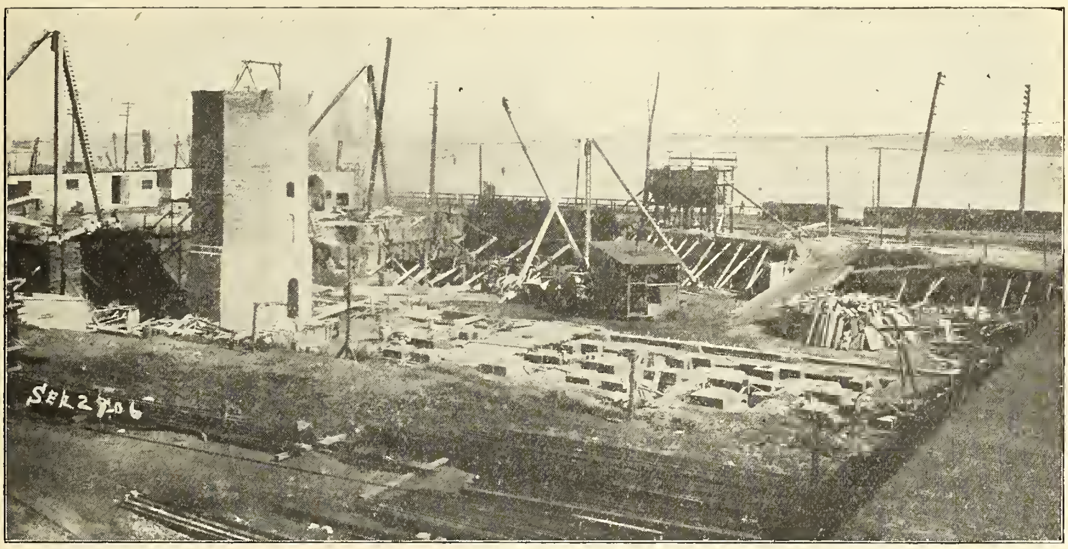
PIPING.

The main steam piping will be of the unit system, leading directly from boilers to engines, having an equalizer for the purpose of transferring from one lead to the other. There will be a separate auxiliary steam header for feeding all the auxiliaries. The engines will be provided with atmospheric exhaust connections, which will be carried to one main riser, and will be located adjacent to the chimney and will extend through the boiler house roof.

A feature of this power house will be the dry well, the floor of which will be located 31 feet below both the engine and boiler room floors, so that all the circulating units and feed pumps, which will be located in this well, can lift the water directly from the wet well. This wet well will be connected with the St. Lawrence river by means of a 5 feet 6 inches diameter concrete tunnel, and the river level will be maintained in the wet well. The maximum suction lift at extreme low water for both the circulating pumps and the feed pumps will be approximately 16 feet 6 inches. The circulating pumps will elevate the condensing water directly to condensers, and the feed pumps will discharge directly through economizers into boilers. The feed piping, however, is arranged so that the economizers can be cut out or bye-passed. The dry well will be substantially waterproof and provided with a drain, the drainage being passed off by an automatically operated pump. The wet wells will be provided with duplicate removable screens, and the water to the wet wells will be controlled by 48 inch diameter sluice gates.

The hot wells and overflow tunnel for same will be constructed of reinforced concrete.

In addition to the engines already noted, there will



HOCHELAGA POWER HOUSE OF MONTREAL STREET RAILWAY, SHOWING FOUNDATIONS.

also be installed one 35 inch by 72 inch by 54 inch vertical cross compound condensing MacIntosh & Seymour engine, direct connected to a 2,000 kilowatt General Electric railway generator.

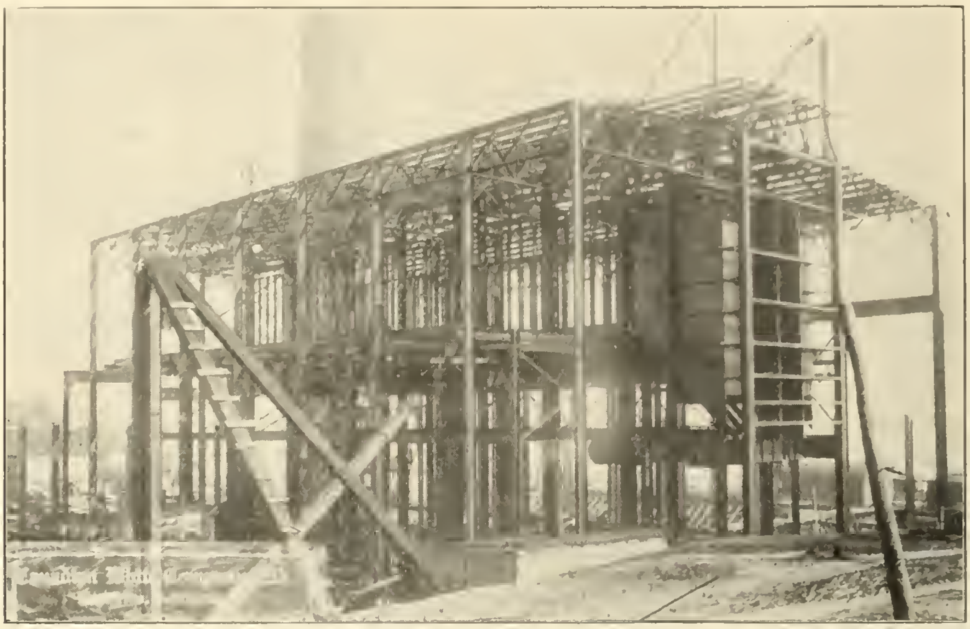
In the steam lead to each engine will be installed a separator and an automatic engine stop valve.

In addition to the main and auxiliary feed lines, each boiler will be provided with an injector, which will be connected so that it will be possible to feed the boilers through these injectors, either from the city water mains or an overhead tank.

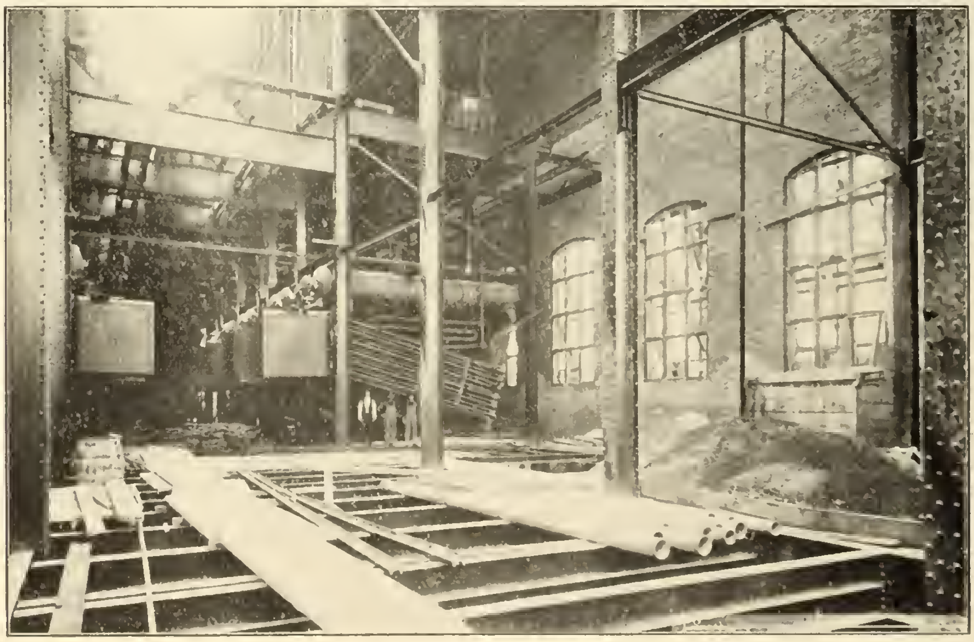
The engine house will be provided with a 4 motor 50 ton electric travelling crane, of the Niles type, the crane trolley being equipped, beside the main hoist, with a 10 ton auxiliary hoist.

In the engine room will be installed a small compressor outfit, for the purpose of bolting generators, also an overhead gravity oil system.

The city of Nelson, B.C., is now supplied by electric light from the new plant at Bonnington Falls.



Hochelaga Power House of the Montreal Street Railway, in Course of Construction.



Hochelaga Power House of the Montreal Street Railway, Showing Boiler Settings.

WIRELESS TELEGRAPH SUIT.

The Dominion Government and the Marconi Wireless Telegraph Company have opened their legal fight. The point in question is whether, when the Government gives notice of its intention to establish a wireless telegraph station, the company has under its agreement the option of erecting and operating that station.

The Government denies this. Therefore Marconi has started legal action to settle this point in the agreement.

Hon. A. B. Aylesworth has advised the Department of Marine that there is nothing in the terms of the agreement to prevent the Crown from erecting a wireless station and equipping it with instruments other than the Marconi instruments.

As a result of this advice the Department has proceeded to establish and operate wireless stations on the Pacific coast independent of the Marconi Company, and will fight the claim of the company for an absolute monopoly of the wireless telegraph business of the Goveernment.

New Montreal Uptown Office of the Bell Telephone Company

The Bell Telephone Company of Canada have recently completed the installation of an entirely new central office equipment for their uptown exchange in Montreal, which has many interesting features. The building was erected by the company on Mountain street, about half way between St. Catherine and Sherbrooke streets, in an excellent residential locality. It is a handsome two storey and basement structure, 56 feet in width by 114 feet in depth, and was designed to harmonize with the character of the adjacent residences, with which it is in perfect keeping.

The front of the basement and the main entrance steps are of dressed limestone, above which it is of maroon pressed brick with light buff terra cotta trimmings. Over the main entrance is a handsome terra cotta porch with a balcony above. At the right of the main entrance on the ground floor are rooms for the accommodation of the operators, consisting of a large sitting room furnished with chairs, lounges, tables, etc., and fitted with a small kitchen, which is in charge of an attendant, and from whom operators may obtain tea or coffee at any time when off duty. Behind this are lavatories, a bathroom and locker room. In the locker room is a clothes drying apparatus, by means of which wet wraps may be dried before being placed in the lockers, which are of expanded metal and are large enough to accommodate the belongings of two operators. On the right of the main entrance is a room for the chief operators and supervisors.

New Uptown Exchange of the Bell Telephone Company, Mountain Street, Montreal.

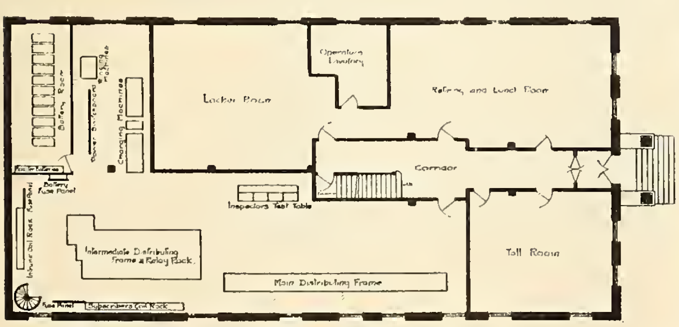
Across the entire rear of the building is the terminal room, which is devoted to the distributing and power apparatus used in connection with the switchboard. The top floor is devoted entirely to the switchboard and is one of the best lighted, best ventilated and most convenient operating rooms in the country. Somewhat of a departure has been made in the construction of the floor of this room, it being built on two levels, the centre part between the two rows of switchboards is some 13 1-2 inches higher than that part upon which the switchboards themselves stand, with the result that while men working at the back of the switchboards have the same ease of access to the apparatus as if the floor was on one level, the operators sit upon a chair of normal height and have no necessity for using a footrest, as is the case with the usual chair which is required with a floor level throughout. With this arrangement the difficulty of reaching such high numbers as require the operator to stand up when she is plugging in is greatly lessened, and at the same time the supervising operators who stand behind the regular operators have a much better chance to see the board and aid the line operators.

The whole scheme is quite novel, it being the first exchange in Canada and, as far as we know, in America, to be so constructed; consequently, it is being watched with a great deal of interest, and will probably be adopted in future exchanges of the company's.

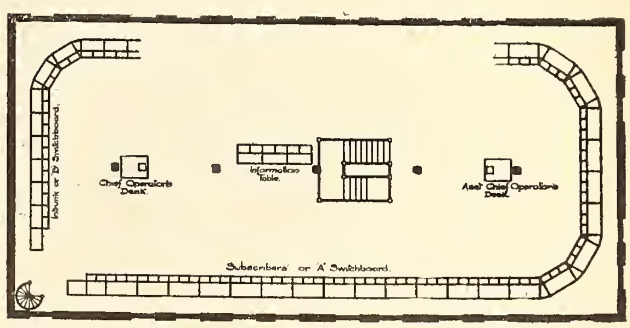
The equipment is of the usual standard battery or relay type, using lamp signals, and is the same as is in use in the east and main offices at Montreal, and such as will be installed in the new Westmount office later in the year.

The lines enter the building underground in 400 pair lead covered paper insulated cables, which are connected to the main frame by silk and cotton insulated lead covered cables. The main intermediate and relay frames, the coil racks for the line and intrunk board with their fuse panels, the power plant and wire chief's desks are all located in the terminal room on the ground floor, arranged as shown in the plan.

The power plant consists of the main battery of 11 G-41 chloride cells and 11 E-11 cells, this last battery being used to reinforce the main battery for long distance work and also to operate certain keys and signals. Two machines are provided for charging the larger battery, one being held in reserve in case of a



Power Room, 110 ft. 6 in. x 55 ft.



Operating Room, 110 ft. 6 in. x 55 ft.

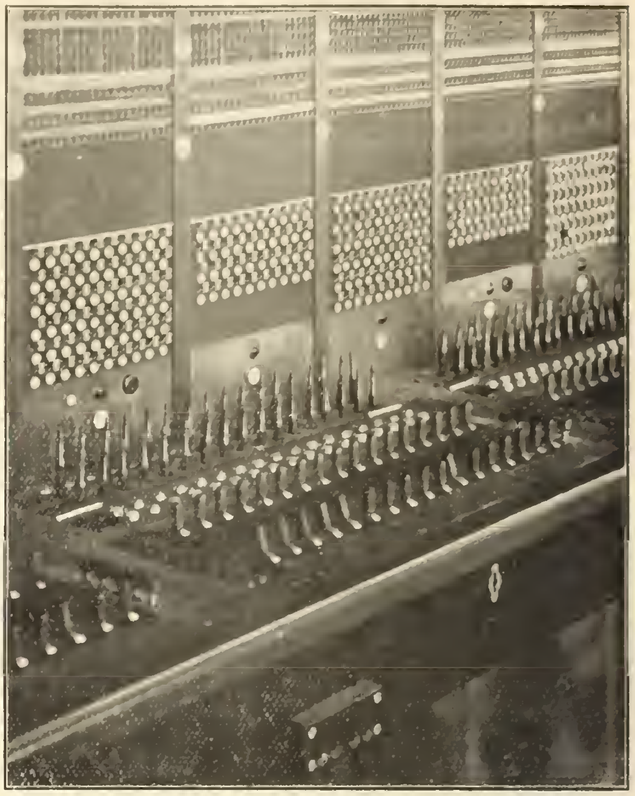
Floor Plans of the New Uptown Exchange of the Bell Telephone Company, Montreal.

breakdown. Each consists of a Westinghouse 30 horse-power induction motor direct coupled to a Western Electric Company's dynamo of 18,000 watts capacity at 30 volts, the two being mounted on a common sub-base. The generators are specially designed for charging telephone batteries, having a large number of segments in a commutator and peculiarly shaped pole pieces, the idea being to eliminate noise from the associated telephone circuits when the battery is being charged. The smaller battery is charged by a similar motor generator, which has an output of 600 watts. Two machines are provided for furnishing current for ringing subscribers' bells and working the many signaling circuits operated by an interrupted direct current. One of these generators is belted to a small alternating current motor, the other is a dynamotor run from the main storage battery. The necessary switches, circuit breakers, measuring instruments, etc., are mounted on a black slate switchboard, the cables from which are carried to the machines and fuse panels along the basement ceiling.

From this terminal room the lines are run to the switchboard on the floor above in switchboard cables supported on structural steel runways. The switchboard is known as the No. 1 relay type, having a capacity of 10,400 lines and equipped at present for 6,400 lines, about 4,300 of which are working. Two separate switchboards are provided, one to answer originated calls of subscribers whose lines terminate at the exchange and which is known as "A" board; the second switchboard is required to complete calls which have originated at other offices for subscribers' lines terminating at this exchange. This switchboard is known as the in-trunk or "B" board. There are seventeen positions adapted to receive calls from other exchanges, and one position for the long distance business of the office, each "B" position having a capacity of twenty-seven trunk lines. The "A" board consists of fifty subscribers, operators' positions and two testing positions, each operator being able to handle the calls from about one hundred and thirty subscribers' lines. Two desks are provided for the chief operator and her assistants, each equipped with facilities to enable them to properly direct the force of the exchange.

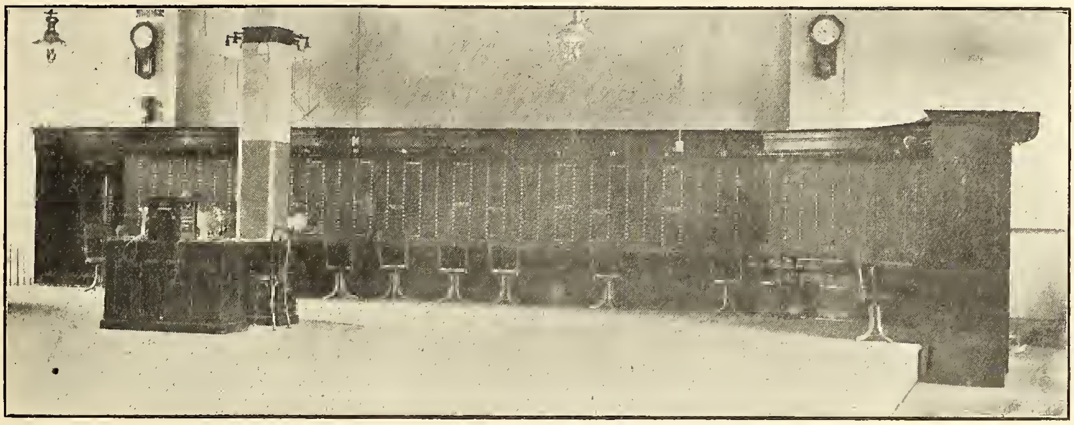
A small six-position switchboard is placed in the middle of the room for the information operators who answer enquiries from the subscribers with regard to new numbers, changes and miscellaneous enquiries. They are also in direct connection with all other offices and assist in straightening out any troubles which may occur in inter-office connections. They can also talk directly to the supervising operators, of whom there is one to every twelve operators at the switchboard; thus, if a connection goes wrong or is prematurely disconnected, a call may be sent to any of the other offices through to the information desk, where one of the operators there can talk directly to all the supervisors in the room at once, by so doing greatly facilitating the location of the trouble in question, as each of the supervisors can go over her twelve positions very quickly and, as they all work at the same time, the whole switchboard is examined very rapidly.

On the whole, the exchange is one of the best and most attractive in the country, thoroughly up-to-date in every particular, and should enable the company to give the best service to its subscribers.

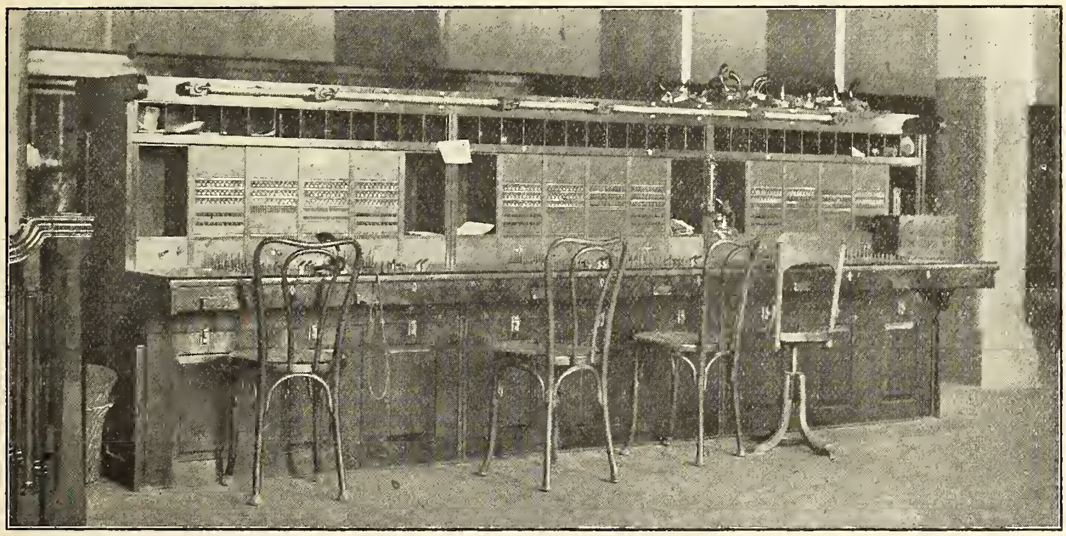


Details of "A" Keyboard, Uptown Exchange Bell Telephone Company.

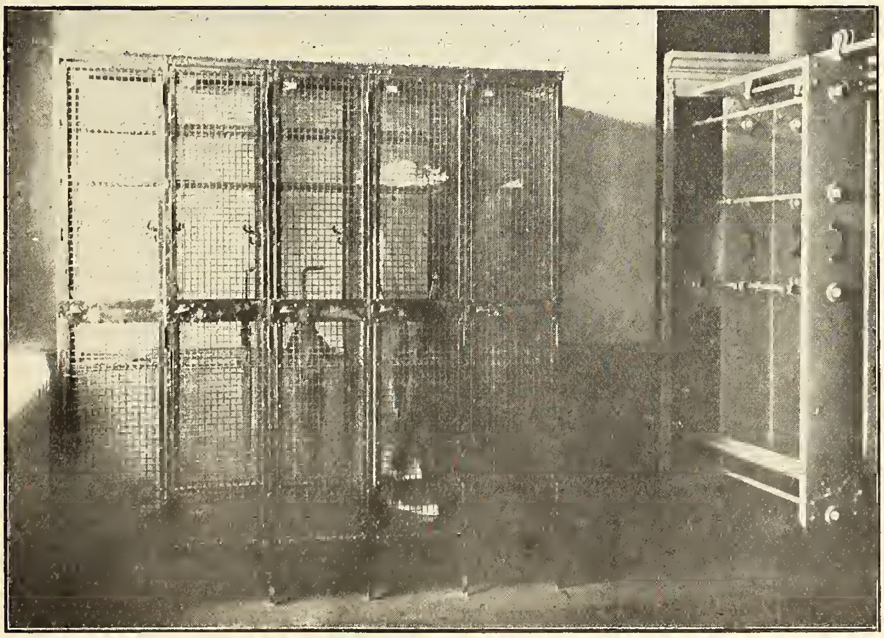
"A" Board, New Uptown Exchange, Bell Telephone Company, Montreal.



"B" Board, New Uptown Exchange, Bell Telephone Company.



Information Table, Uptown Exchange, Bell Telephone Company.



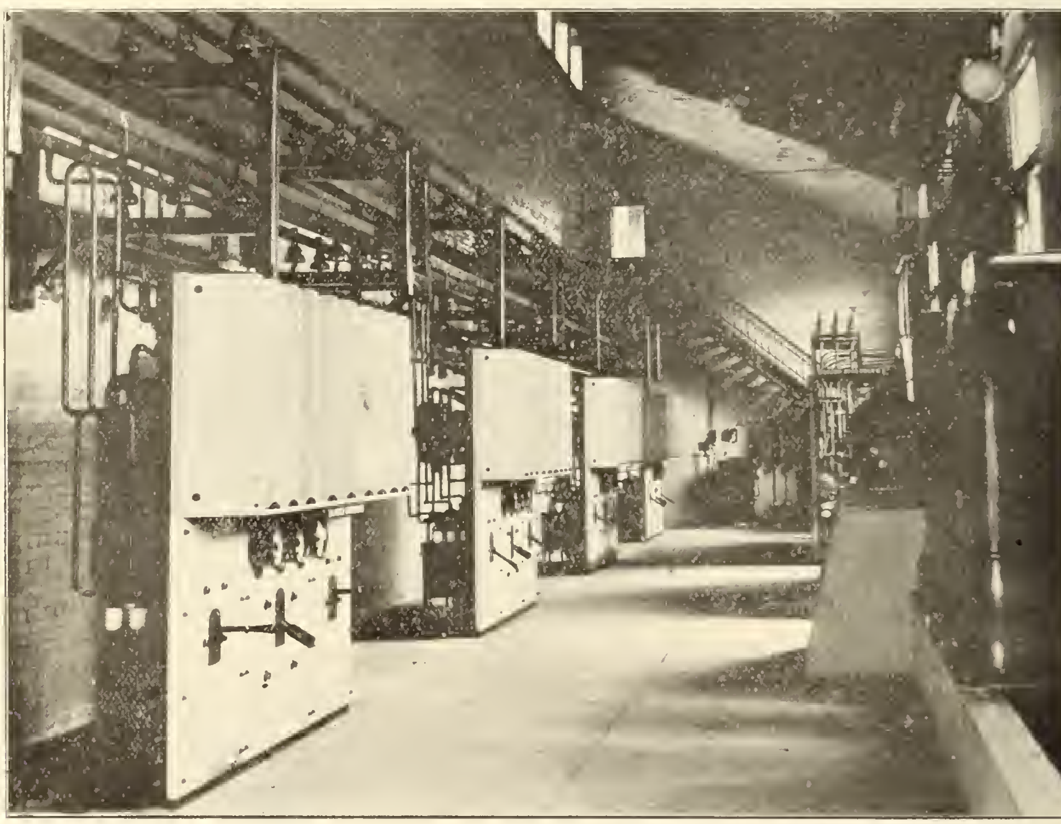
Portion of Cloak Room, Showing Type of Lockers and Clothes Dryers.

VIEWS OF UP-TOWN EXCHANGE OF THE BELL TELEPHONE COMPANY, MONTREAL.

The Hydro-Electric Plant of the Canadian Niagara Power Company

Through the kindness of Mr. Philip P. Barton, general manager of the Canadian Niagara Power Company, we are permitted to present herewith some very interesting photographs, pertaining more particularly to the step-up transformer system and supporting towers of that company, and in connection therewith will give a brief description of the plant and methods of operation.

The power house of the Canadian Niagara Power Company is situated in Queen Victoria Niagara Falls Park, on the bank of the Niagara river, about one-fourth of a mile above the Horseshoe Falls. It is the oldest of the three large power developments on the Canadian side of the river at Niagara Falls, and is typical of what might properly be termed the "Niagara" scheme of power development. Three of the five developments located in the Niagara district are of this same type.



Canadian Niagara Power Company—Low Tension Bay of Step-up Transformer Plant, Showing 11,000 Volt Switchboards and Bus-Bars.

The general scheme of development consists in an intake canal and forebay drawing water from the river above the Falls, a wheelpit, or long narrow shaft sunk in the solid rock to a depth corresponding to the height of the Falls, in which the hydraulic machinery is located, and a tunnel discharging the water from the bottom of the wheelpit to the river below the Falls. The power house superstructure is built lengthwise over the wheelpit and adjoins the outer forebay. It contains all the electrical machinery. Penstocks pass down the wheelpit to the turbines installed near the bottom and the mechanical power there generated is transmitted through vertical shafts to the electrical generators located in the power house floor.

A covered chamber extends along the forebay side of the main building. The outer wall of this chamber acts as an apron wall and the water passes into the chamber, or inner forebay, through arched openings below the surface and then through iron racks into the individual intakes of each penstock and turbine. The purpose of the apron wall and of the iron racks in the inner forebay is to remove all floating ice, logs and other solid matter which, if allowed to pass into the penstocks, would tend to clog the turbines, causing loss in output and possibly serious damage. Any accumulation of such floating matter is returned to the river below the main intake canal through a small sluiceway canal extending from the lower corner of the forebay next the power house. The flow of water into the sluiceway canal from the outer and inner forebays is regulated by depression gates.

The ultimate capacity of the plant of the Canadian Niagara Power Company will be 110,000 horse-power, divided into eleven units of 10,000 horsepower each. At present only five units have been installed, and only the lower half of the power house superstructure has been completed to accommodate these five units. The intake canal, wheelpit and tunnel, however, are complete for the full installation of 110,000 horsepower, and additional units of 10,000 horse-power will be installed and the power house extended as required. The five units now installed are already loaded to their full capacity, and plans for the installation of a sixth unit are being prepared.

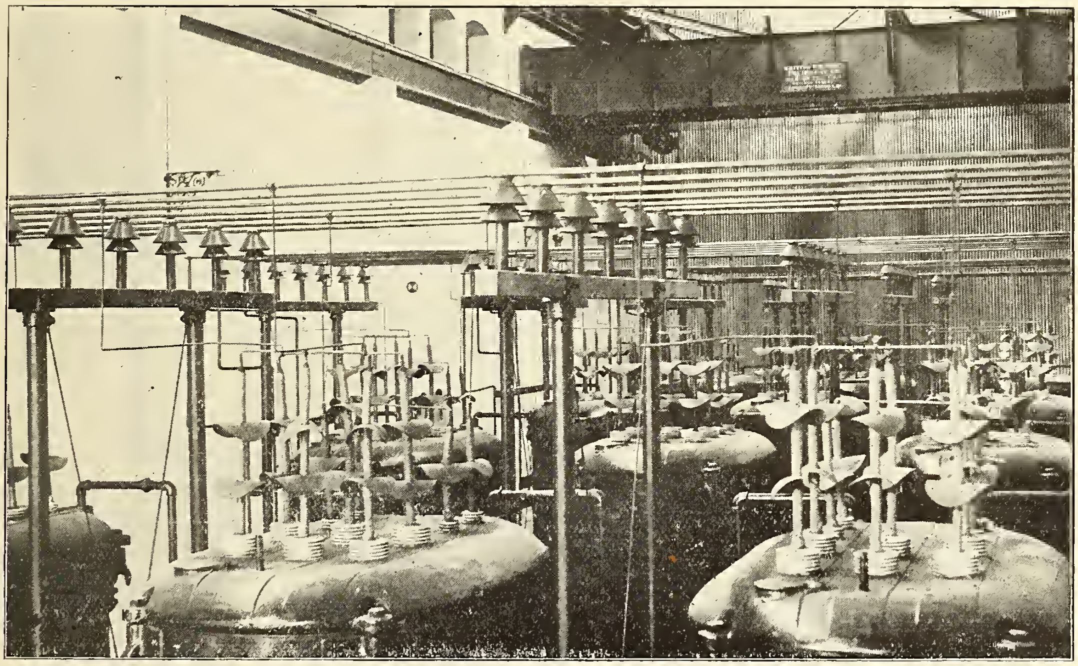
The turbines are the Francis double inward discharge type, with draft tubes, and were designed by

Escher, Wyss & Company, of Zurich, Switzerland, by whom the first three were built and installed. The last two were built and installed by the I. P. Morris Company, of Philadelphia. The governors operate by oil under high pressure on the principle of a balanced valve, and were designed and built by Escher, Wyss & Company.

The electrical power is generated at 11,000 volts, 25 cycles, three phase, and is to a very large extent distributed at this voltage. The main generators are of the internally revolving field type, with an open Y winding in the armature, and were designed and built by the General Electric Company. A fourth cable is brought out from the neutral point in the winding, but up to the present time the generators have been operated without grounding this neutral point. The exciting current is supplied at 125 volts.

The final design of the power house contemplates two main controlling switchboards, one controlling a bank of five generators, or 50,000 horse-power, and the other a bank of six generators, or 60,000 horsepower. It is felt that an aggregate of 60,000 horsepower is as much power as can be safely placed under the control of one man. These two main switchboards will be at different ends of the power house, centrally located opposite the generators which they control. Both switchboards, however, will be interconnected by cables, which, together with the sectionalizing of the bus bars controlled from each switchboard, permits of almost any combination or subdivision of power desired. The first main switchboard has already been installed in connection with the five units now in operation.

This switchboard is located directly over a large subway running the full length of the power house adjacent to the wheelpit. Iron racks or shelves built up of channels extend along the sides of the subway and contain the outgoing feeder cables. In the subway, directly under the switchboard structure, are the main 11,000 volt bus bars, from which the power generated is controlled and distributed. There are two parallel lines of bus bars running lengthwise of the subway, each line being divided into two sections at the centre. This gives four sets of separate and distinct three phase 11,000 volt bus bars, which are numbered from 1 to 4, inclusive. Bus bars Nos. 1 and 2 correspond with sections which are directly opposite each other at one end of the two parallel lines, and bus bars Nos. 3 and 4 are at the other end. Directly over the two lines of bus bars, on the level of the power house floor, a double row of oil switches is located, controlling the feeder and generator circuits. These are contained in a long chamber under the switchboard gallery. The oil switches are motor operated, triple pole, 500 ampere, 13,200 volt, Form H3 switches of General Electric Company make. Each three phase feeder or generator circuit runs to three copper U bars just under the power house floor, which act as a cross connection between the inside oil vessels of two oil switches located back to back in the double row referred to above. Through one or the other of these two oil switches, the feeder or generator circuit can be thrown on either of the two lines of main bus bars in the subway below. The outer vessels of the oil switches are connected each to its respective bus bar by means of copper tubing, in which suitable knife blades are installed. Each bus bar and all copper tubing, disconnecting switches, hook-operated disconnecting switches and oil switch vessels are enclosed in separate compartments, built of brick and soapstone, to minimize the danger of short circuits.



CANADIAN NIAGARA POWER COMPANY—VIEW OF TOPS OF STEP-UP TRANSFORMERS, SHOWING THE METHOD OF BRINGING OUT THE LEADS AND CONNECTIONS THERETO.

Of the bank of five 10,000 horse-power units controlled from the switchboard already installed, three generators with ten feeders can be thrown on either bus bars No. 1 or No. 2, and two generators with ten feeders can be thrown on either No. 3 or No. 4. As the two opposite sections of the two lines of bus bars can be paralleled through the feeder or generator switches, and as the two sections of each line of bus bars can be cross-connected through bus injunction cables, greater flexibility can be obtained than is at first apparent. Each feeder has 4,000 horse-power capacity, and consists in one No. 000 three-conductor cable, insulated with varnished cambric and braid for

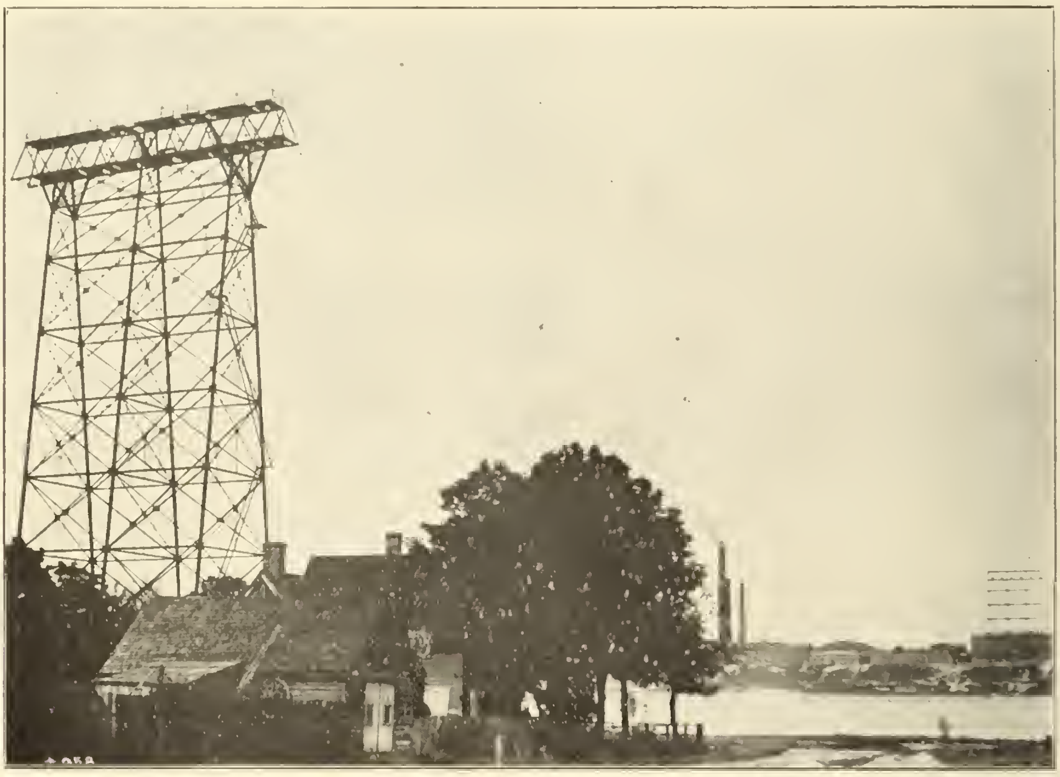
the distance that it runs in the racks through the main subway.

In the racks, the cables are supported on electrose saddles. Outside of the power house lead-sheathed paper or rubber-insulated three-conductor cables are used, laid in conduits.

Only low voltage current is brought to the main operating switchboard on the gallery above the oil switch chamber. The switchboard consists of twenty feeder panels, five generator panels and two bus injunction panels. At either end are five additional panels, on which are mounted the polyphase integrating wattmeters, measuring the power distributed over the feeders. On each feeder panel are mounted two indicating wattmeters, three ammeters, one in each leg of the three phase circuit, two control switches for the two motor-operated oil switches, by which the feeder can be thrown on one set of bus bars or the other, and the automatic overload relay. On each generator panel are two wattmeters, one ammeter, one voltmeter, a d. c. ammeter measuring the field current, a control switch or the motor-operated field rheostat, two control switches for the two motor-operated oil switches of each generator, the field circuit breaker switch and two single-pole double-throw switches, by which the field circuit can be thrown on either of two sets of d. c. bus bars.

On the generator panels, the control switches for the motor-operated oil switches are inoperative when thrown unless a supplementary six-point hand plug switch has been inserted in the generator panel in question. This hand plug switch also closes the synchronizing circuits from the potential transformers of the generator and of the bus bars on which it is to be thrown to the Lincoln synchroscope, centrally located on the top of the switchboard, and as there is but one hand plug but one step can be made at a time, necessitating deliberate action on the part of the operator and minimizing the danger of errors under emergency conditions.

The 11,000 volt series and potential transformers for all measuring instruments and for the synchronizing circuits are all located in separate brick compartments, forming an integral part of the bus bar structure in the main subway. A common ground wire is used for one leg of all circuits from the secondaries of these transformers, giving absolute protection against high voltages on the operating switchboard in case of the breakdown of any transformer. Two sets of 125 volt d. c. bus bars run in the back of the switchboard panels, and are used not only for the field circuits but also through supplementary bus bars having proper switch and fuse protection for all motor control circuits, pilot lamps, etc. The main 11,000 volt bus bars are diagrammatically represented along the face of the switchboard panels, and the control switch for each motor-operated oil switch is located on the panel just below the diagrammatic line of the bus bar on which the motor throws the oil switch. Red and green pilot lamps indicate the on and off position of these switches.

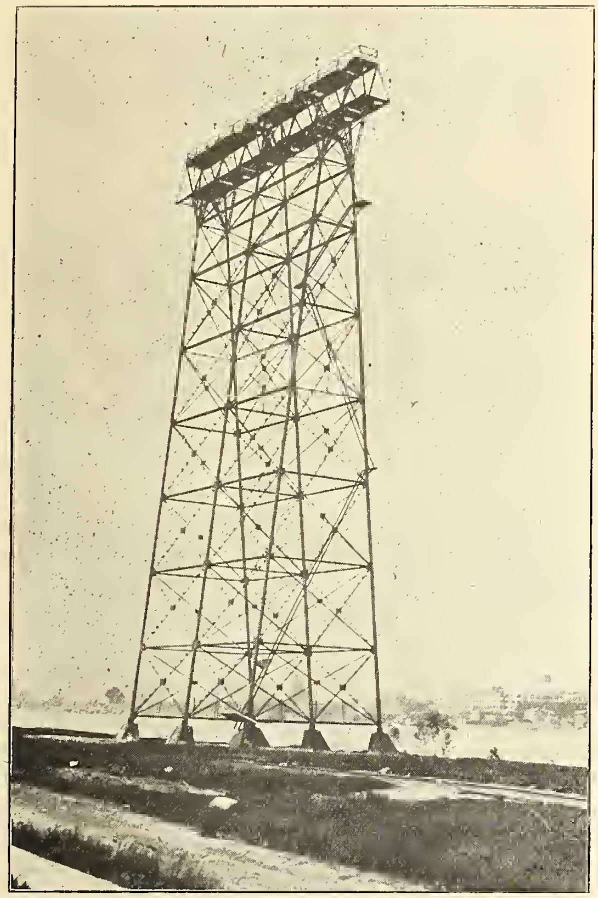


Canadian Niagara Power Company—General View of Long-Span Crossing of the Niagara River Between Fort Erie and Buffalo, from the Canadian Side.

The exciter plant consists of three 200 kw. 125 volt vertical shaft 750 revolutions per minute Westinghouse generators, turbine driven, located with the necessary switchboard in a chamber near the bottom of the wheelpit at the level of the turbine deck. From this point the direct current energy is distributed over feeder cables to the d. c. bus bars in rear of the main switchboard gallery on the power house floor, and to other points of use. Direct current is used for the motors operating the head gates, tail gate, water pump, oil pumps, cranes, semaphores and arc lamps.

There are two other chambers in the wheelpit off the turbine deck in which are installed the water pumping plant and oil pumping plant. Two horizontal centrifugal pumps of 2,000 gallons per minute

capacity each are located in the water pump chamber, one turbine driven and one which can be either turbine or motor driven. One pump has sufficient capacity for all requirements. In connection with the water pumping plant, the Power Company has erected a large standpipe on the bluff above the power house, having at least 24 hours' storage capacity under maximum requirements. The water, aside from the necessary fire protection and sprinkler systems, is principally used in the cooling coils of transformers and generator bearings, for cooling oil in the suction tanks of high pressure pumps and for a hydraulic elevator.



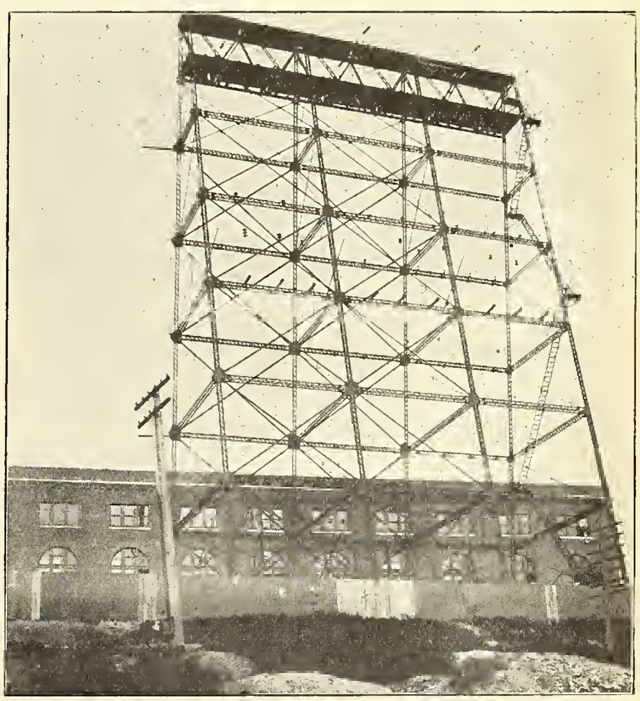
Canadian Niagara Power Company—High Tower at Fort Erie Supporting the Long-Span Crossing.

The Quimby oil pumps in the oil chamber are also both motor and turbine driven. The oil is pumped to a large storage tank just under the roof of the power house, and from that point is delivered to the generator bearings and guide bearings in the wheelpit. From the bearings it returns to the suction tanks of the oil pumps by gravity. In the oil chamber are also installed filters and boiling, separating and cooling tanks, these last being used to separate any water which may mix with the oil from the turbine bearings in case of a leakage of water through the stuffing boxes. A second oil pumping system is installed in a sub-chamber under the main oil chamber, and supplies oil to the bearings of the main turbines and exciter units.

High pressure oil pumps of a single acting three cylinder type, designed and manufactured by Escher, Wyss & Company, are installed on the thrust deck, just below the power house floor. There are two pumps for each unit, supplying oil for the governor and thrust bearings respectively. The pumps for each unit are driven through gearing and countershafting from the main shaft of the 10,000 horsepower unit. A spare pump, motor driven, is used on the thrust bearings in starting and shutting down the units, or in case of accident to any of the regular pumps. The thrust bearing consists of two discs, the lower one stationary and the upper one attached to the revolving shaft. Between these two discs oil is forced under heavy pressure, the weight of the shaft and revolving parts amounting to 250,000 pounds, being carried by a film of oil between the two discs. The weight of the revolving parts is also counterbalanced by the hydrostatic upward pressure of water in a compartment of the turbine wheel case acting upon the lower surface of a disc secured to the shaft. This balance piston and thrust bearing are designed so that either alone is sufficient for the purpose intended.

Of the twenty 11,000 volt three phase feeders distributing power from the main bus bars, eight act as interconnecting cables, supplying 11,000 volt power direct to bus bars in the plants of the Niagara Falls Power Company at Niagara Falls, N.Y., running through a line of conduits in the Queen Victoria Park and crossing at the upper steel arch bridge, and eight run through conduits to the step-up transformer station, situated near the standpipe on the bluff in rear of the power house. The balance distribute power for local use and for the lighting and heating load in the power house.

The step-up transformer station contains four banks of step-up transformers, and a fifth is now being installed. Each bank has a capacity of 5,000 horse-power and consists of three 1,675 horse-power oil-insulated water-cooled transformers, built by the General Electric Company, which change the current from 11,000 volts, three phase, to either 22,000, 33,000, 40,000 or 60,000 volts, three phase, by slight changes in the connections. The present connections used are for 22,000 volts, at which voltage the power is transmitted to Fort Erie and Buffalo over two 12,500 horsepower capacity tri-phase transmission circuits about

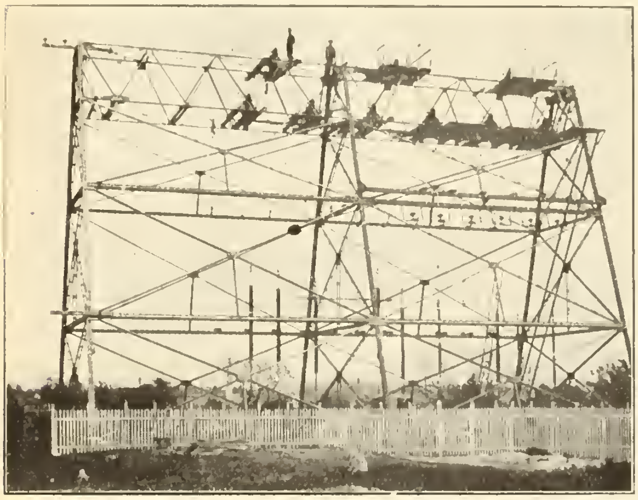


Canadian Niagara Power Company—Tower at Buffalo End of Long-Span Crossing, with Terminal Receiving Station.

sixteen miles long. The receiving station at Buffalo is interconnected with the Buffalo terminal station of the Niagara Falls Power Company, which, with the interconnection at the Niagara Falls end gives great flexibility and assures the power tenants in Buffalo of practically continuous service. This is especially valuable during lightning storms, as it is exceedingly improbable that a storm would ever extend over a sufficient area to cause simultaneous interruptions on both the Canadian and American transmission systems.

The two transmission circuits of the Canadian Niagara Power Company run on a single pole line of special steel construction, designed by the Power Company's engineers. The spans are three hundred feet, and the conductors aluminum cables 500,000 c. m. in cross section, having 37 strands. The cables are supported on electrose insulators, with a hood 12 inches in diameter screwed on malleable iron pins.

A special feature of the transmission circuits is the crossing over the Niagara river, between Fort Erie and Buffalo. The character of the river at this point made submarine cables impracticable, and an overhead crossing was chosen. As the river is navigable,



Canadian Niagara Power Company—Strain Tower at Fort Erie End of Long-Span Crossing.

a clearance of at least one hundred and thirty feet above the water was necessary. The distance between shores is about 1,620 feet, but on account of waterways and railroads paralleling the river on the Buffalo side, the shortest distance between supporting towers which could be obtained was about 2,200 feet.

The cables start from a small prominence in Fort Erie at an elevation of 104 feet above the river, and rise to an elevation of 212 feet at the intermediate supporting tower on the Canadian bank of the river, and from there cross to the American tower, the top of which is 215 feet above the river. The sag of the cables in this span is about eighty feet. The lengths of the two spans are 1,668 and 2,192 feet respectively. At the two end towers of the spans, the aluminum cables are connected to steel cables, which pass over large sheaves to counterweights weighing 4,300 pounds each. These counterweights maintain a uniform tension in the aluminum cables at all times, adjusting all expansion and contraction and relieving the cables of all sudden wind stresses. Electrose strain insulators of a spool type are used between the steel counterweight cables and the main span cables and electrose insulators are also used at the supporting saddles of the centre tower. At the end towers drop leads from the main cables carry the current down and through the towers to the line cables at the Canadian end and to the terminal station at the American end. At the centre tower a flexible chain connection about 25 feet long is introduced in each cable, where they pass over the supporting saddles to take up the vibrations in the main cables. For the crossing between Fort Erie and Buffalo the aluminum cables are 500,000 c. m. in cross section, having 61 strands.

In addition to the Fort Erie transmission circuits, two tri-phase 2,200 volt overhead power circuits about five miles long run from the transformer station, furnishing power to the city electric light plant and various local power tenants in Niagara Falls, Ont. Power for these circuits is supplied from two banks of air blast transformers, located in the transformer station. These step-down from 11,000 to 2,200 volts. Each bank consists of three 250 kw. Westinghouse transformers.

One of the difficulties of operation of all of the power plants in the Niagara district is the satisfactory handling of ice during the winter months. The Canadian Company accomplishes this by the use of an electric tug installed in its outer forebay, which successfully breaks up all ice formations and, when held stationary, propels the floating ice towards the sluiceway canal at the lower end of the forebay by means of the surface current of water which is set in motion by its propeller. The electrical equipment on the tug consists of two 75 horse-power single phase alternating current Westinghouse railway motors geared direct to the propeller shaft, a single drum controller for parallel control and an air blast transformer giving a range for the speed control of the motors of from 56 to 220 volts in the secondary, with 1,100 volts impressed on the primary. The trolley voltage is 1,100 volts, supplied from an oil-insulted water-cooled transformer located in one of the power house sub-floor chambers. Power for this transformer is supplied at 11,000 volts from the main bus bars. The trolley wires are two No. 00 copper wires, two feet apart, extending the full length of the forebay, and giving a wide range of operation for the tug. They are supported from two sixty-foot poles with porcelain disc strain insulators. A trolley carriage of special design travels along the wires with the movement of the tug, and from this carriage the power is conducted to the tug through a pendant duplex rubber-insulated cable.

ERRATUM.

Through an unfortunate oversight, it was stated in the August number of the Electrical News that the generator at the East Toronto municipal plant was furnished by the Canadian Westinghouse Company. The contractors for the generator were Allis-Chalmers-Bullock, Limited, of Montreal, to whom credit should have been given.

It is reported that the Cataract Power Company of Hamilton are negotiating with the Windsor, Essex & Lake Shore Electric Railway officials with a view to purchasing the road.

SUCTION GAS ENGINE VERSUS STEAM PLANT.

By L. G. Read, M. E.,
Managing Director and Chief Engineer Colonial Engineering Company.

A practical comparison between a suction gas engine plant and a steam plant cannot fail to be of interest to the manufacturers of Canada—since the total cost of power, after everything has been added, constitutes one of the largest fixed charges in the manufacturing business, and, as a rule, it is a department which receives less expert attention than any other department in the business.

We are installing a number of Hornsby-Stockport suction gas engine plants in the Dominion of Canada now on absolute guarantees of operating cost.

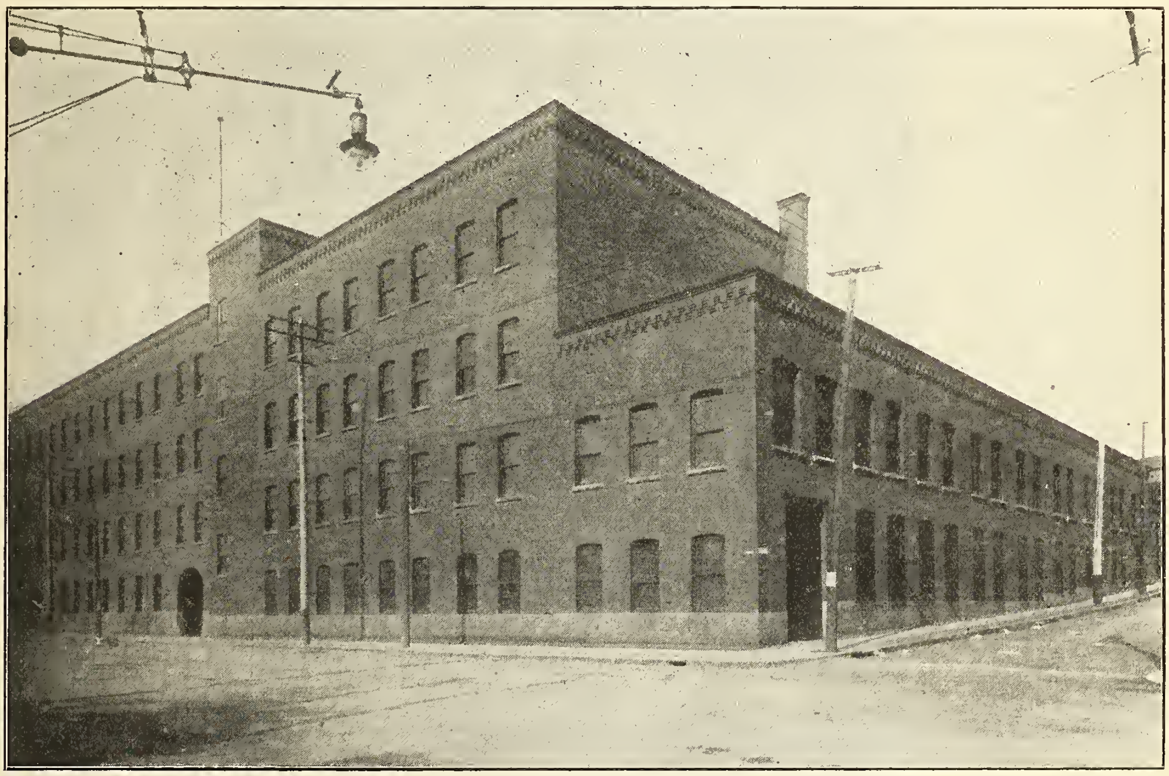
In sizes from 50 h.p. up we find no difficulty in demonstrating a fuel economy which, plus other operating costs, will deliver a b.h.p. on the shaft of the engine for 300 days of 10 hours each at a total cost of only $12. Our repeated success in obtaining this result warrants us in making a guarantee to this effect.

The best design of steam engine plant—even compound condensing—cannot do better, including auxiliary units and standby losses, than say $30 per annum per h.p. The difference between $30 and $12 saved per annum per h.p. amounts to $1,800 per year on a 100 h.p. equipment, or $4,500 per year on a 250 h.p. requirement.

Taking the cost of a 250 h.p. suction gas engine plant at, roughly, $16,500, this saving of $4,500 a year would pay for the new equipment in, say, 3 1-2 years.

A 250 h.p. compound condensing steam engine equipment, with the best type of water tube steam boilers, feed water heaters, fuel economizers, live steam purifiers and all of the auxiliary equipment of the most refined character, with the proper coal handling device and with a thoroughly first-class chimney, it is safe to say that the total initial investment would be fully equal to that of the gas engine installation, and making a direct comparison between the two plants in point of fuel economy, it can be demonstrated, with overwhelming evidence, that the best average the steam plant can show, under ordinary daily working conditions, throughout the year is 3 to 3 1-2 pounds of coal per h.p. hour. As against this the gas engine plant will easily show an economy between 3-4 and 1 pounds of anthracite pea per b.h.p. hour, and, furthermore, the continued economy of the gas engine plant does not depend directly upon the intelligence of the attendants, whereas it is a recognized fact that the economy and general efficiency of a steam plant depends directly upon the intelligence with which it is handled from day to day. Again, the amount of attendance required in the case of the gas engine plant is very greatly less than that of the steam plant, owing, first, to the fact that the equipment is entirely automatic, and, second, the amount of coal actually to be handled is, say, from one-third to one-fifth that required in the steam plant. The consequent saving also in the ash handling and general maintenance in the plant is most decidedly in favor of the gas engine.

We are under contract to-day to install for Ames-Holden, Limited, Montreal, 200 h.p. Hornsby-Stockport suction gas engine equipment—supplanting steam engines and naming, in our guaranteed cost of operation, a very much lower price than any outside power company could name. The same facts apply to Lamontagne, Limited, Notre Dame street, Montreal, 100 h.p. They are throwing out steam engines, and would not even consider the price named by outside power companies. The same applies to Viau Freres, the large biscuit makers in Maisonneuve, and to the Modern Printing Company, St. Vincent street, Montreal; also the Empire Manufacturing Company, London, Ont.; Anchor Fence Company, Stratford, Ont., and very recently the City of Chatham, Ont., gave us a contract for a complete new municipal electric lighting plant—throwing out high speed automatic steam engines in order to effect the great economy which we are prepared to guarantee.



Office and Works of the Wire & Cable Company, 241 Guy Street, Montreal.

THE PUMPING PLANT OF THE OMAHA WATER COMPANY.

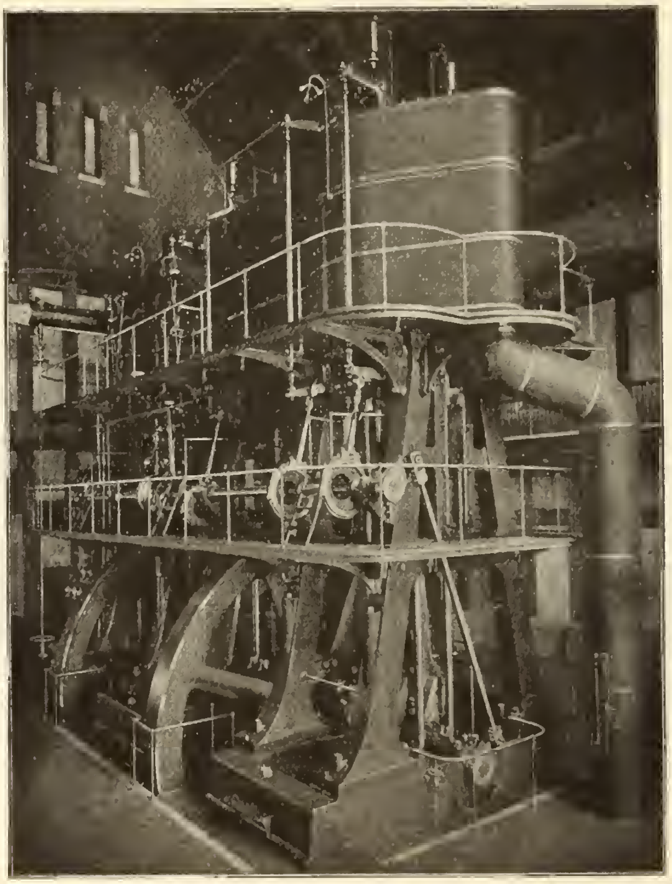
By Willis Collins.

From the standpoint of high economy continuously maintained throughout a long period of time, the central station of the Omaha waterworks system, equipped with Allis-Chalmers pumping engines, has a record of more than ordinary interest, as will be seen from the following account.

The construction of this system was begun in 1880, when the population of the city was only 30,000, and completed in 1883. When completed the system had 28 miles of water mains and 250 fire hydrants. The Missouri river was the source of supply. The water was first pumped up about 30 feet to four large basins on the river side, where sedimentation took place, considerably clarifying the water. The clarified water flowed to the suction of the high-lift pumps, which discharged to a 10,000,000 gallon reservoir on Walnut Hill. Water was supplied to the city of Omaha, South Omaha, and the suburbs of Dundee, Florence and East Omaha. In 1886 the average daily consumption was about 6,000,000 gallons.

In 1887 a new central pumping station was built at Florence, Neb., which is located several miles up stream on the Missouri river, beyond all danger of sewage contamination to the water. The plant is surrounded by 107 acres of parked ground, and is called by the Indian name for pure water, viz., Minelusa. The mechanical equipment of this plant is particularly fine. Although some of the machinery has been in operation for nearly 20 years, the record for economy and reliability is most creditable and comparable with pumping plants built 10 or 15 years later. The low service and high service pumps are installed in the same station, and supplied with steam from a common boiler plant.

The first installation consisted of two 12,000,000 gallon vertical compound, crank-and-flywheel pumping engines of the Allis-Chalmers type to work under a head of 70 feet for the low service, and one 18,000,000 gallon vertical triple expansion pumping engine of the Allis-Chalmers type to work under a head of 310 feet for high service, discharging to reservoir and distribution system. The low service pumps deliver the water to a series of sedimentation basins on the bank above the river; these basins being arranged with a series of cascades between adjacent basins, with water levels carried so as to give a drop of 2 feet or 3 feet over each series of cascades. The cascades have sills perfectly level, and long enough to carry the maximum amount of water in a very thin sheet. Air is admitted freely behind the falling water. This complete aeration of the water, alternated with complete rest in the sedimentation basins, has a wonderful clarifying effect, and practically removes all of the red silt from the river water by the time it reaches the last basin. The clear water flows to the high-lift pumps under a slight head.



Vertical Triple-Expansion Pumping Engine.

In 1898 the increase in water consumption demanded additional pumping capacity, and an 18,000,000 gallon Allis-Chalmers vertical compound pumping engine was installed for low service duty, and a little later, in 1902, a 20,000,000 gallon vertical triple Allis-Chalmers pumping engine was installed to give increased capacity for the high service system, making in all five Allis-Chalmers pumping engines, with an aggregate capacity of 80,000,000 gallons per 24 hours. All of these pumping engines have records for reliability—there has never been a break requiring a shut-down for repairs.

The first vertical triple expansion pumping engine has the following cylinder diameters; h.p. 40 inches; i.p., 70 inches; l.p., 104 inches, and the stroke of all is

60 inches. These cylinder sizes were very much larger than anything ever designed for pumping engine work at that time. The total weight of the machine was about 1 1-2 million pounds. The introduction of this unit reduced the consumption of fuel 50 per cent., and for some years was claimed to be the most economical pumping engine unit in service, requiring but 1 1-2 pounds of coal per h. p. per hour.

The second vertical triple expansion pumping engine has steam cylinders of the same diameters as corresponding cylinders on the first engine, but the stroke is increased to 66 inches. Each pumping engine makes 20 revolutions per minute, and the second machine has 10 per cent. greater capacity on account of the longer stroke. The second machine is of the "self-contained" type, with the steam engine supported by the pump chambers.

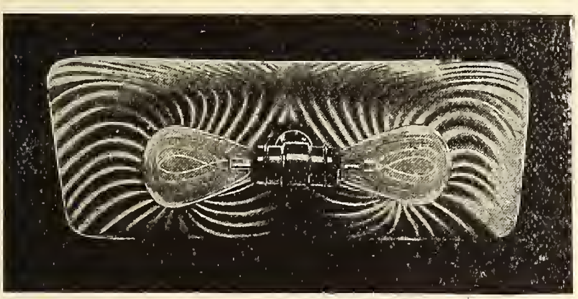
There are now 230 miles of water mains, and about 15,000 service connections to the Omaha water system.

THE NEW REFLECTOR.

Among the new things which have been marketed within the last two years, perhaps the new reflectors known as the "X-Ray" have had more to do with making electric light more popular than any other one thing.

X-Ray reflectors are made in various designs, each design being manufactured for some especial purpose. For instance, one reflector is designed primarily for lighting show windows, another for reflecting light in great volume on a small surface, another for spreading light, such as may be necessary in large hallways, store basements and assembly halls, still another for bowling alleys, billiard tables, desks, etc.

The property that, according to the claims of the manufacturers, makes these reflectors so superior to others is the reflecting surface, which is pure sterling silver. It is well known that silver is the best reflective surface known to science, but up to the time these reflectors were made it was impossible to obtain a silver reflecting surface that did not require much time in its care, on account of tarnish, etc.



Poke Bonnet, Interior View, Showing Spiral Corrugations, Twin Socket and Two Lamps.

The problem was solved in this case by using reflectors made of finest blown glass, coating the back side with silver and covering the plating with an elastic enamel that would not craze or crack. Hence, the silver reflecting surface never tarnishes, cracks or clouds.

The reflectors themselves have had as much care given to their shape as to their reflecting surface. The spiral corrugations are designed scientifically, so that no shadow of the filament is thrown. The rays of light are diffused and the volume is greatly increased.

While the purpose of these reflectors is to reflect, they are really ornamental. The window reflectors have shown themselves so efficient, in many cases making show windows so much lighter than ever before, and at the same time reducing the cost for current, that they have sprung into high favor, and progressive firms everywhere are using them.

One or two illustrations with this article give an idea of the shape of some of the reflectors. They are made by the National X-Ray Reflector Company, of Chicago, U.S.A.

Ceiling Reflector with Cluster.

ART OF CUTTING METALS.

"The Art of Cutting Metals," by Frederick W. Taylor, M.E., Sc.D., which was the presidential address presented at the last annual meeting of the American Society of Mechanical Engineers, has been reprinted and bound in cloth by the Society, price $3. This or any other publication of the Society may be had by addressing the secretary, 29 West 39th street, New York. It is not necessary to send orders through members. None of the publications of the American Society of Mechanical Engineers are copyrighted.

GASOLINE TORCHES.

The "Baby" gasoline torch is a practical tool for a score of trades. It combines utility with compactness, has volume without bulk, and avoids the troublesome features of other torches. It is purely automatic, works without air pressure, has no pump or valves to get out of order, lights with a match, and burns about two hours on a gill of fluid. It will burn benzine, naptha and gasoline. It can be carried in the tool bag of any one using tools. The illustration herewith is two-thirds the actual size.

The Sayer Electric Company, Beaver Hall Hill, Montreal, are Canadian agents for the "Baby" torch.

COST OF A MUNICIPAL LIGHTING PLANT.

To install a municipal lighting plant for supplying the city of Hamilton with arc lamps would cost over $121,000, according to an estimate supplied by P. W. Sothman, chief engineer of the Hydro-Electric Commission. The following is his report.

POWER DISTRIBUTION.

Beach pumping house	1,000 h.p.
High level pumping house	100 h.p.
Asylum	100 h.p.
Ferguson avenue disposal works	50 h.p.
East end annex	50 h.p.
Street lighting	300 h.p.
Total	1,600 h.p.

Capital cost, with fixed operating charges, on power lines:—

Total capital cost, with engineering and contingencies and interest during construction	$20,410 00
Fixed charges per annum	$1,767 00
Operating cost per annum	750 00
	$2,517 00
Loss on power on lines	324 00
	$2,841 00

STREET LIGHTING—ARC LAMPS.

Five hundred magnetite arc lamps, to be operated from motor generator sets:—

Station equipment, capital cost	$30,674 00
Outside equipment, capital cost	91,050 00
Total	$121,724 00

Which amounts include allowances for engineering and contingencies and interest during construction.

	Per lamp per year.
Fixed charges	$28 92
Power	6 94
Renewals	3 00
Wages	3 60
Oil, waste, etc	1 00
	$43 46

TOTAL ANNUAL COST.

Fixed charges	$14,460
Power	3,470
Renewals	1,500
Wages	1,800
Oil, waste, etc	500
	$21,730

The expenditure indicated above includes that for over 45 miles of pole line construction, which would be available for power and lighting distribution. If one-half of this pole construction were charged to a power and lighting service the cost of arc lighting would be reduced by $4.75 per year per lamp, and the cost of power for arc lighting would also be reduced, owing to the fact that the capacity required for street lighting could be utilized by motor users.

The equipment suggested is believed to be the best that could possibly be procured, and is calculated to give the cheapest service consistent with high efficiency and reliability. The lamps are long burning, luminous arc, giving an effective illumination at least one-third greater than the present 480 watt a. c. lamp.

The synchronous motors in the estimate have such overcapacity as will enable them to effect an annual saving on power supplied to induction motor users of over $1,200 per annum. This would result in a further reduction in the cost of street lights of $2.40 per lamp.

NERNST LAMPS.

Capital cost of poles, wire, lamps, etc., $93.50 per lamp, on which the fixed charges are $10.25 per annum.

The operating charges are: Power, $3.75, renewals, $6, making a total cost of $20.01 per lamp per year. It can also be stated that the cost of this service will be reduced by $2 per lamp or more, if the annual cost of pole construction were shared by a lighting and power service. It may be safely predicted that two of these lighting units would give nearly as efficient illumination as one arc, and three would be somewhat more effective. Such small lighting units would be highly desirable in portions of the city where foliage is heavy.

If the renewal changes on the new high efficiency incandescent lamps could be reduced they would prove desirable for residential street lighting.

It should be stated in connection with the above estimate that circuits of these lamps could be operated at the above cost only when such street lighting service shares in the cost of larger transformers installed for incandescent lighting service.

It is intended that these circuits shall be operated by switches controlled by the series of street lighting circuits. If the number of arc lamps estimated on were replaced partially by Nernst lamps or other small lighting units on multiple circuits, the cost of the arc lighting per lamp might be slightly increased.

Negotiations looking to the purchase of the Ottawa Electric Railway, the Ottawa Electric Light Company, and the Ottawa Gas Company, are reported to have been begun by an American corporation.

TESTING OIL.

For either engine or cylinder service a good oil should have body enough or sufficient viscosity to prevent the surfaces to which it is applied from coming into actual contact. Perhaps this is the most important qualification of good oil, and with a careful viscosity test a good oil will not be rejected or a poor oil accepted. Viscosity is closely related to the density of an oil. The simplest means of determining the viscosity of an oil is to test the time of flow of a certain volume of oil through a small orifice as compared with the time of flow of the same volume of good oil or water. The oils and water compared must be tested at the same temperatures, and preferably at the temperature to which the oil is to be subjected. A copper or glass vessel with an orifice of about one-sixteenth of an inch in the bottom is satisfactory, except where very large quantities of oil are used. In the latter event the purchase of a viscosimeter will doubtless pay the company. Accurate tests of the viscosities of oil as compared with water have given the following results: Prime lard oil, 3.6; sperm oil, 2.2; castor oil, 2.6; rape seed, 4.2; the temperature in these tests being 68 degrees Fahrenheit.

Freedom from corrosive acids, the maximum fluidity possible with the required viscosity, a minimum co-efficient of friction, high flash and burning points and freedom from elements liable to produce oxidation or gumming, are all desirable features of oil for power plant service. To identify an animal oil or a vegetable oil, chlorine gas may be applied. The former is turned brown and the latter white by its action, and if there is no opportunity for further chemical tests this method of attack will often serve the purpose in a rough way, though it throws no more light upon the composition of the oil than a calorimeter test of coal exhibits the constituents of a fuel sample.

The flash and burning tests may be readily made by placing a sample of the oil in a small receptacle having a tight cover through which a thermometer can be inserted. A small hole is essential in the cover to allow the vapors to escape as the oil is heated. The vessel should be gently and slowly heated through a layer of sand, and when the oil is hot a lighted match or an incandescent wire may be passed over the hole to observe the temperature at which the oil flashes. The burning point is obtained by continuing the heating and noting the last temperature observed at the time the oil takes fire. The gumming and oxidation characteristics may be obtained by noting the time required for a small amount of oil to flow down a smooth inclined plane with the time taken by a like amount of good oil to flow over the same course.

The simplest method of finding the density without the use of instruments is to find the loss of weight of some body in oil and in pure water. The ratio of the loss gives the density as compared with water. Animal oil densities may run from 0.62 to 0.9; sperm oil at 39 degrees Fahrenheit has been found to have a density of 0.88; rape seed, 0.91, and cotton seed, 0.92.

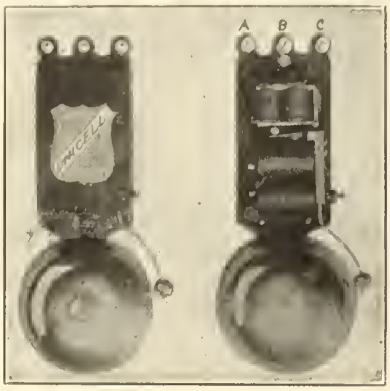
Moisture in transformer oil may be detected in several simple ways. By reason of its specific weight moisture in transformer oil will generally be found at the bottom of the case. As most cases for oil shipment, including transformers, are provided with plugs, it is an easy matter to secure a sample from the bottom in a test tube. By providing the latter with a tight cork and bent glass tubes about 1-8 inch in diameter and heating the test tubes, the moisture in the oil will condense in the upper part of the small tube and will be prevented by the bend from falling back into the oil. A second method is the application of a red hot wire to the oil, a crackling sound following the presence of moisture and simply a puff of smoke if the oil is dry. A simple chemical test consists of driving off the water in a few crystals of copper sulphate by roasting. This leaves a white powder, and when oil is added to this the original blue color returns if the oil contains moisture. Of course, these tests are approximations, but they are useful in plants where the services of a skilled chemist are not available, which is the case on many electric railways. Needless to say, records of oil consumption and overheated bearings should invariably be made in power plants.—National Electric Light Association.

REDUCING POWER DEMAND IN EMERGENCY.

No matter how far-sighted the engineers of a company may be, it is always within the bounds of possibility that there will be a shortage of power at critical times. It is therefore vitally important to consider the means of saving power which can be adopted when the need is great. Waste of power is always objectionable, but there is a difference between the losses permissible in ordinary practice and those enforced by unusual and extreme conditions. When a road is short of power it should be clear that the cars have the first claim upon the generating plant. So far as possible auxiliary uses of power should then be confined to non-peak hours. If necessary the large tools in the shops can be shut down before the maximum load appears at the switchboard. If it be cold weather greater care can be taken in regard to the use of car heaters. Motormen can be urged to coast more if their schedules allow it, though proper feeding is admittedly one of the hardest problems to settle satisfactorily. Something might be done through the use of watt-meters on the most hilly lines with a bonus for the lowest power record in a given time. On a pinch it may pay temporarily to install more feeders. The bonding of the track should not be overlooked. Economy of power production is not the point at issue in times of severe shortage. It is better to generate at a sacrifice of the usual efficiency than to cut off the car service. Even reduced speeds are preferable to lengthened headways, from the public's standpoint. There is no time when it pays better to get in close touch with the public than when some unavoidable occurrence reduces the station capacity below par. It is a question if the advantages of frankness at such times are fully appreciated in railway circles, but it is a well-defined truth that much inconvenience will be cheerfully borne by the public if the patrons of the company are encouraged to learn that the company is doing its best to meet the situation. There is no doubt that a great deal of bad feeling, and often appeals to state boards, can be avoided by taking pains to inform the public in a brief but comprehensive way of the reason for poorer service than usual. The essential point is to show that a power shortage is not in effect for the purpose of greater profits but to enable the company to handle the traffic without decreasing the transportation facilities.—Electrical Railway Review.

NEW STYLE ELECTRIC BELL.

A new style of electric bell has recently been patented by Messrs. Emile Lionais and Wm. T. Sutton, of Montreal, which combines several novel features, together with distinct advantages over the ordinary type of bell. The invention consists principally of the combination of a relay and electric bell and is so arranged that only a local battery is required to work both the main circuit and local circuit. The bell is compact and neat in appearance, and is equipped with three binding



NEW STYLE ELECTRIC BELL.

posts, A, B, and C, and the platinum contact on the relay armature also acts as the contact breaker for the bell. When the bell is connected up for use on any circuit up to 25 ohms resistance one cell of battery only is required, which is connected to the binding posts A and B, the main line and push button circuit is then connected to B and C. On closing the push button the current passes from the battery to binding post B, thence by the other wire through the push button and back to binding post C, through the relay coils, which are wound to comparatively high resistance and back to the battery by binding post A. This energizes the relay magnets and this attracts the armature, thereby bringing the platinum point mounted thereon into contact with the interrupter spring on bell armature, thereby closing a shunt circuit through the bell by way of binding post B, through bell magnets to interrupter spring and relay armature, and thence by a wire to binding post A. Thus it will be seen that only a small portion of energy is required to attract the relay armature, and the balance is all available for ringing the bell. This bell can be used to advantage in a great many ways, on telephones, using the local battery at each phone for ringing the bell, and as a return call it is excellent, requiring only two wires to be run between the bells and bridging them at any point by one or more push buttons. In connecting up a number of bells to ring simultaneously from one or more push buttons, they are connected in series through the relay coils, thus making it possible to increase the length of the circuit for each bell placed thereon, and as each bell is run only from its own battery excessive sparking is avoided at the contact breaker. A system of 26 of these bells is being installed in the new Ville Maria Convent on Sherbrooke street, Montreal, and as they have had several severe practical tests, there is no reason why there should not be a good market for them.

AN ATTRACTIVE EXHIBIT.

The Sunbeam Incandescent Lamp Company of Canada and The Holophane Company will be much in evidence at the Electrical Exhibition in Montreal this month. They will have a most beautiful exhibit of new Tungsten, Tantalum and Standard Carbon Filament lamps, combined with Holophane prismatic shades.

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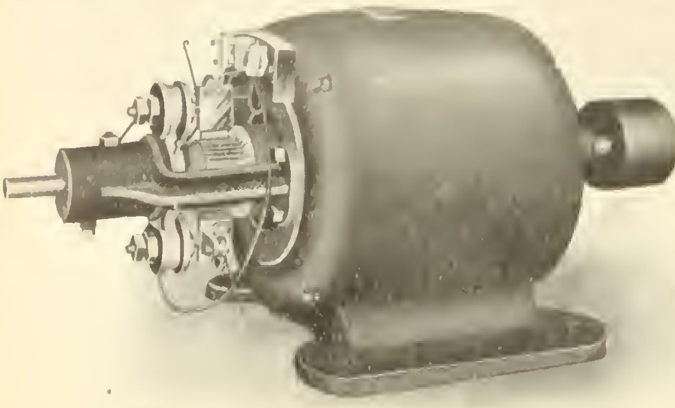

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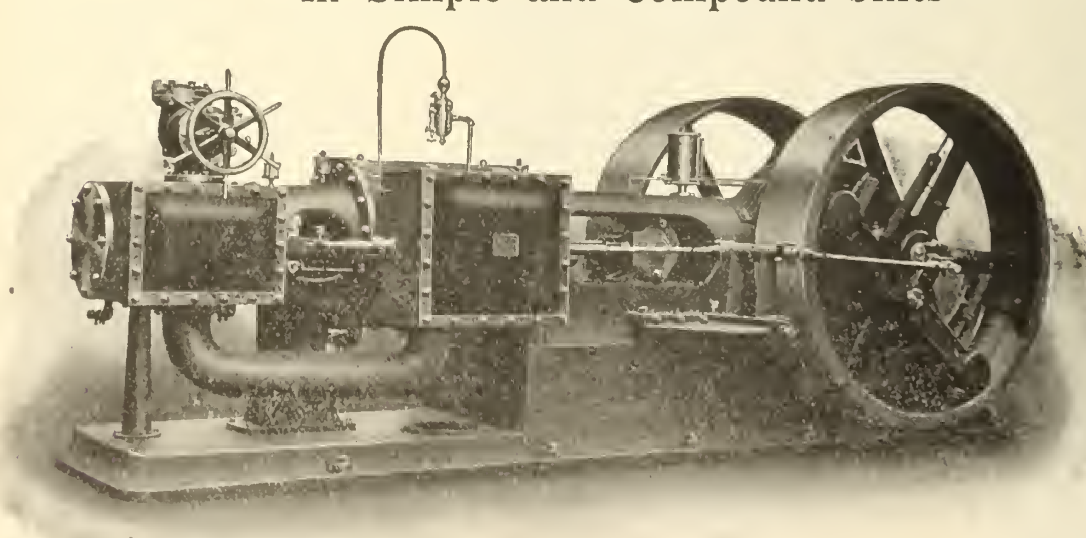

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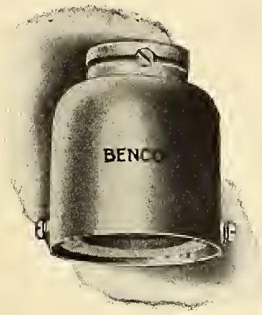

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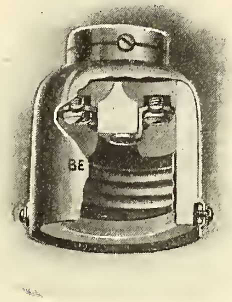

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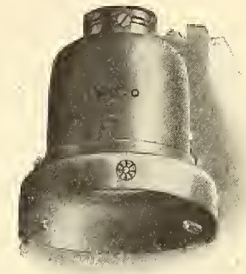

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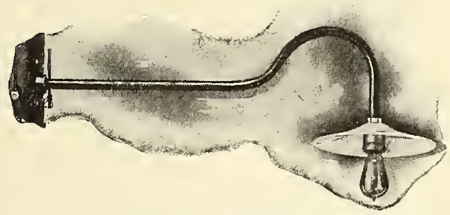

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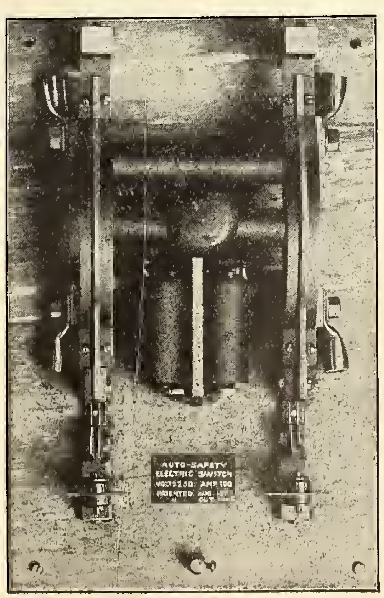

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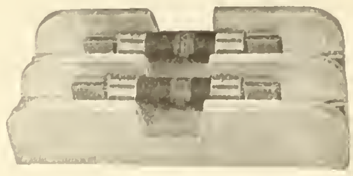

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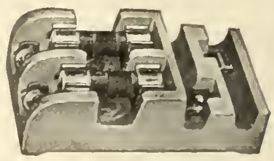

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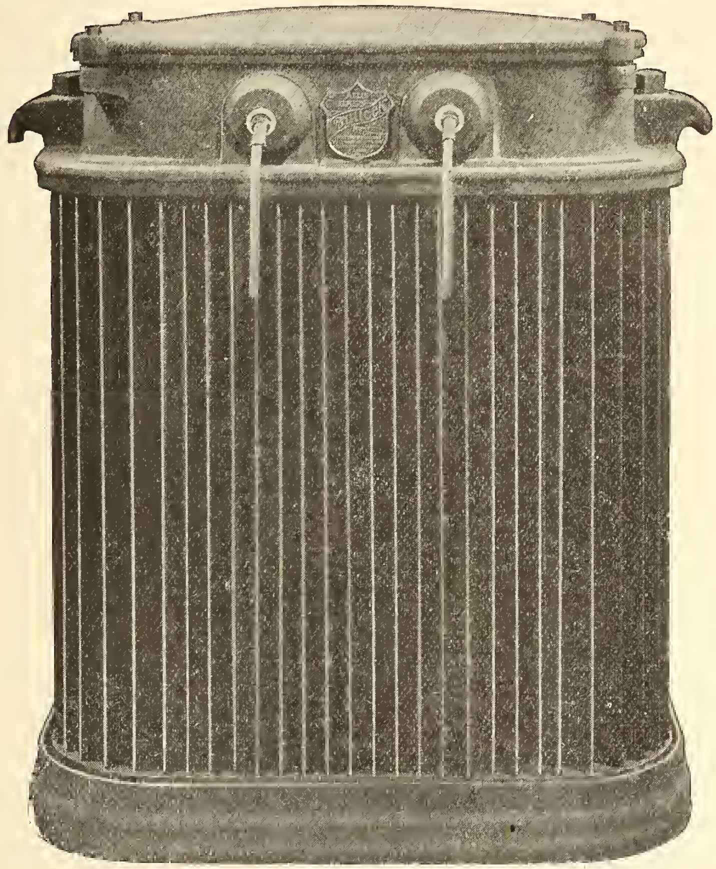

This is a view of one of our 10 k. w. Lighting Transformers. Bulletin 300 describes our full line of Lighting Transformers. Among the good points are:

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SPARKS.

The ratepayers of Moose Jaw, Sask., are this month voting on a by law to raise $90,000 for extending the electric light plant.

The Canadian Westinghouse Company's branch office in Vancouver, B.C., has been removed from Hastings street to 439 Pender street.

The City Council of Nelson, B.C., are considering the advisability of extending the electric light service to supply adjacent farming districts.

The Martin Electrical Supply & Construction Company have been awarded the contract of installing between 300 and 400 new electric lights in the Whitman & Barnes Company's works.

A company has been formed for the promotion of an electric railway to run from Kenora to Keewatin, and thence along Winnipeg river, where it will connect up with the Grand Trunk Pacific.

A $60,000 power house is about to be built for the municipality of Campbellford, the contract having been awarded to Messrs. Bogue & Buchanan. About 5,000 horse-power will be developed.

The by-law to guarantee the bonds of the Ontario West Shore Electric Railway to the extent of $25,000 was defeated last month. Saltford gave 39 of a majority, but Leeburn polled a big vote against.

The Woodstock Electric Railway, Light & Power Company, Woodstock, N.B., are offering for sale several direct current dynamos and motors and two Ideal engines. The plant has been changed to alternating current.

The Edmonton City Council have been negotiating for the purchase of electric power from the city of Strathcona. The Fire and Light Committee of Strathcona have recommended the sale at 7 cents per kilowatt hour, provided that Edmonton provides the transmission.

The city of Calgary, Alberta, needs more electric power. The Calgary Power & Transmission Company, better known as the successors to Alexander & Budd, are making preparations for supplying it, while the Alberta Portland Cement Company will have something like 7,000 h.p. for sale.

An addition to the electric light plant at Wetaskiwin, Sask., is now being made. It consists of a 127 kw. Westinghouse alternator, a 190 h.p. Westinghouse gas engine, and a 225 h.p. R. D. Wood gas producer, to be installed in the present electric light power house. The cost of the extension will total $35,000.

A Canadian patent has been granted to Mr. J. S. Nesbitt, of Victoria, for an electric flash sign. This sign is designed as a combination letter frame, the partitions of which are so arranged that through the medium of a commutator the desired word may be spelled out by the successive flashing of the various letters.

The Nova Scotia Telephone Company has completed the purchase of the stock of the Central Telephone Company, which built and operated the line between Bridgewater and Middleton. This plant consisted of seventy miles of poles and ninety miles of wire. The Nova Scotia Telephone Company intends reconstructing the line and will put in new cedar poles and metallic circuit.

General Greene, of Buffalo, representing the Niagara Power Company, had an interview recently relative to the regulations which are being drawn up by the Dominion Government to govern the export of electric power to the United States. Before these regulations are finally adopted the Government will afford opportunity for the various companies to express their views thereon.

The Londonderry Iron Mining Company, who recently acquired the iron deposits at Torbrook, N.S., from George E. Corbitt, are preparing to install an electric system for operating their mines. The power will be drawn from the Nictaux Falls, about a mile from their property. The mills which were formerly operated at the falls have been abandoned, to make way for the utilization of the water power for electrical purposes. The estimated cost of this plant is between $40,000 and $50,000.

PUBLICATIONS.

The Canadian General Electric Company have recently issued printed literature calling attention to their "Gem" lamps and "P. & B." dry battery.

"Electroless" is the name of a new preventative of the electrolysis evil which the H. W. Johns-Manville Company, of New York, have placed on the market. It is a sectional covering of a specially prepared asbestos paper in laminated form, thoroughly impregnated, and coated with a high grade waterproof insulating compound, which is claimed to present an effective barrier to the transmission of electric current.

The Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric controlling devices, have just issued a booklet—pigeon-hole size—descriptive of their line of electric crane controllers. In addition to full descriptions and illustrations of five types of crane and hoist controllers, the booklet contains connection and dimension diagrams, repair part charts, prices, net weight and shipping weight of apparatus, etc. An improved form of contactor for handling heavy currents is also described.

The "Ideal" engine catalogue, which has recently been issued by the Goldie & McCulloch Company, of Galt, Ont., is a very interesting and artistic production. It is divided into two parts, the first being devoted to Ideal high speed engines of the centre crank type, and the second to side crank Ideal engines for direct connection. Separate descriptions and illustrations are given of the frame, cylinder, valves, stuffing box, piston, connecting rod, crosshead, throttle, governor, etc., to thoroughly acquaint the reader with each part. The Goldie & McCulloch Company will forward a copy of this catalogue to anyone interested.

The financial statement submitted by the Secretary-Treasurer showed a balance in the bank to the credit of the Association on June 1st, 1907, of $1,124.22.

PERSONAL.

Mr. and Mrs. Harvey Hubbell, of Bridgeport, Conn., were guests at the Montreal Electrical Exhibition.

Mr. R. Henry Mainer, secretary-treasurer of the James Stuart Electric Company, of Winnipeg, attended the Electrical Show in Montreal.

The death occurred a few days ago of Lieut.-Col. F. C. Henshaw, of Montreal, who had been a director of the Montreal Light, Heat & Power Company, the Montreal Park & Island Railway, the Suburban Tramway & Power Company, and the Canadian Marconi Wireless Company.

TRADE NOTES.

The Chase-Shawmut Company, of Newburyport, Mass., have recently placed upon the market a newly approved Stage Pocket, reconstructed to comply with new rules by the Board of Fire Underwriters, which require pockets to be fused on switchboard. In placing this article upon the market the Chase-Shawmut Company have taken into careful consideration the rough usage received by articles of this nature in street railway park theatres, etc., and believe that this simple, safe and durable pocket will fulfill all requirements.

As the result of a very successful test given at Moncton, N.B., on September 5th, an electric box signalling system which will render railroad collisions, both head-on and rear-end, almost impossible, may go into extensive use on the Intercolonial Railway. The system, which is known as the electric block, was invented by Mr. H. W. Price, lecturer on applied electricity in the University of Toronto, and is controlled by the Standard Signal Company of Toronto, and guards not only against collisions, but broken rails, misplaced switches, and open draw-bridges. It will also signal danger to an approaching train should a car or portion of a car on a siding be projecting over into the main line.

CLASSIFIED INDEX OF ADVERTISERS.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XVII. OCTOBER, 1907 No. 10.

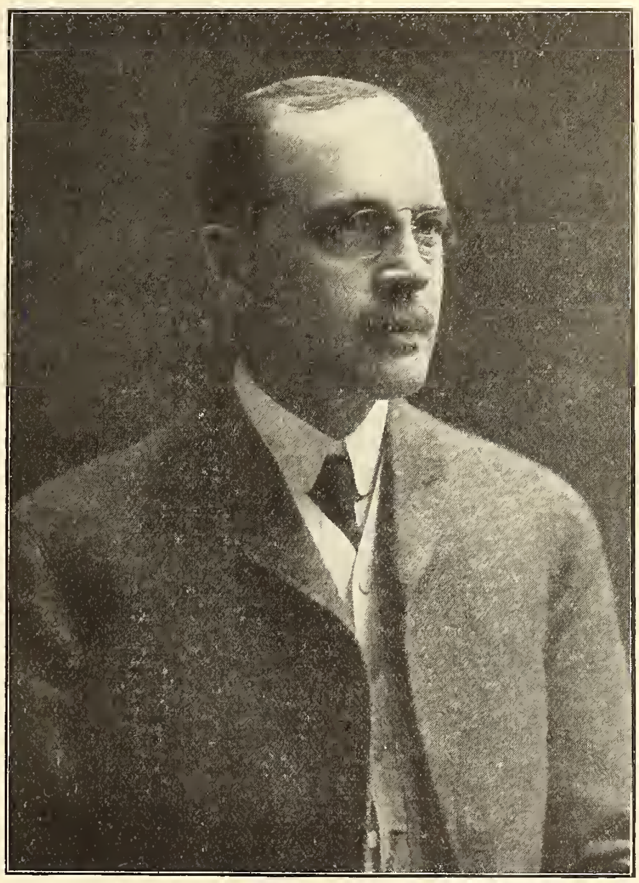
Canadian Electrical Association Convention

The seventeenth annual convention of the Canadian Electrical Association was held at the rooms of the Canadian Society of Civil Engineers, Montreal, on Wednesday, Thursday and Friday, September 11, 12 and 13, 1907.

The President, Mr. R. G. Black, occupied the chair, and called the convention to order at 10.30 a.m.

The following persons were present:

W. L. Adams, Ontario Power Company, Niagara Falls, Ont.
yes J. G. Archibald, Electric Light Department, Woodstock, Ont.
B. F. Anderson, Canadian Westinghouse Company, Hamilton.
Henry D. Bayne, Canadian Westinghouse Company, Hamilton.
J. A. Burns, Munderloh & Company, Montreal.
Rev. Henry Barker, All Saints, Rosendale, New York.
L. J. Belnap, Allis-Chalmers-Bullock, Montreal.
C. W. Bongard, C. W. Bongard Company, Toronto.
Acton Burrows, "Railway and Marine World, Toronto.
D. P. Burke, Ottawa & Hull Power Company, Ottawa.
George C. Burnham, Allis-Chalmers-Bullock, Toronto.
D. E. Blair, Montreal Street Railway, Montreal.
Fred. J. Booth, J. R. Booth, Ottawa.
Wm. A. Bucke, Canadian General Electric Company, Toronto.
J. H. Bryson, Pembroke Electric Light Company, Pembroke.



Mr. R. S. KELSCH,
President of the Canadian Electrical Association, 1907-8.

S. S. Anderson, Sandwich, Windsor & Amherstburg Railway Company, Windsor, Ont.
J. L. Allan, J. A. Dawson & Company, Montreal.
W. M. Andrew, Canadian Westinghouse Company, Toronto.
C. Brandeis, Consulting Engineer, Montreal.
Lewis Burran, Quebec Railway, Light & Power Co., Quebec.
R. G. Black, Toronto Electric Light Company, Toronto.
T. Beecroft, Electric Light Department, Barrie, Ont.
H. S. Brown, Canadian General Electric Company, Toronto.
V. Boyd, Canadian General Electric Company, Toronto.
Alex. Barrie, Wire & Cable Company, Montreal.
N. S. Braden, Canadian Westinghouse Company, Hamilton.
F. John Bell, Packard Electric Company, Montreal.
H. E. Blatch, Canadian Westinghouse Company, Montreal.
W. M. Bristol, Canadian Westinghouse Company, Montreal.
J. A. Bremner, Canadian General Electric Company, Toronto.
Wm. C. Brown, Consulting Engineer, Montreal.
H. N. Bartlett, Quebec Railway, Light & Power Company, Quebec, Que.
W. M. Brennan, Allis-Chalmers-Bullock, Montreal.
James W. Crosby, Halifax Tramway Company, Halifax, N.S.
Alfred Collyer, Allis-Chalmers-Bullock, Montreal.
Ernest Craig, Montreal Light, Heat & Power Company, Montreal.
T. O. Crandell, Electric Light & Water Works, Picton, Ont.
J. J. Campbell, Canadian Westinghouse Company, Montreal.
S. G. Chambers, Chambers Electric Light & Power Company, Truro, N.S.
G. Percy Cole, Allis-Chalmers-Bullock, Montreal.
P. R. Colpitt, City Electrician, Halifax, N.S.

Stanley Chambers, Chambers Electric Light & Power Company, Truro, N.S.
F. A. Chisholm, St. Johns Electric Light Company, St. Johns, Que.
H. D. Crouch, Northern Electric & Manufacturing Company, Montreal.
J. B. Dougall, Electric Light Plant, Barrie, Ont.
Cecil Doutre, Commissioner of Wireless Telegraphy, Dominion Government, Ottawa.
John Dorais, Can. Electric Light Company, Levis, Que.
A. P. Doddridge, Quebec Railway, Light & Power Company, Quebec.
J. A. Davis, Canada Eelctric Company, Amherst, N.S.
Leo Denis, Quebec Jacques Cartier Electric Company, Quebec.
J. M. Deagle, Cataract Electric Company, Orangeville, Ont.
A. A. Dion, Ottawa Electric Company, Ottawa.
J. A. Dawson, J. A. Dawson & Company, Montreal.
R. A. Dunlop, Accountant, Halifax, N.S.
S. E. Doane, National Electric Lamp Association, Cleveland, Ohio.
Fred. Deagle, Georgian Bay Power Company, Eugenia, Ont.
Clarence E. Delafield, Ohio Brass Company, Mansfield, Ohio.
F. B. DeGress, Crocker Wheeler Company, New York.
Henry Domville, Vernon Floor Dressing Company, Montreal.
A. Esling, Canadian General Electric Company, Toronto.
H. O. Edwards, Canadian General Electric Company, Toronto.
Herbert Ewan, Montreal Steel Works Company, Montreal.
F. M. R. Evans, National Lamp Association, Cleveland, Ohio.
M. Evers, Bell Telephone Company, Montreal.
R. B. Emerson, St. John Railway Company, St. John, N.B.
Edward A. Evans, Quebec Railway, Light & Power Company, Quebec, Que.
Edward P. Featherstonhaugh, Canadian Westinghouse Company, Winnipeg.
Simeon Fortin, Laval University, Quebec, Que.
A. E. Fleming, Canadian Westinghouse Company, Hamilton.
F. R. Fulton, E. F. Phillips Electrical Works, Montreal.
A. S. Forman, John Forman, Montreal.
J. Farquhar, Electrical Contractor, Halifax, N.S.
P. A. Freeman, Halifax Tramway Company, Halifax, N.S.
H. O. Fisk, Peterboro Light & Power Company, Peterboro'.
James F. Forbes, Allis-Chalmers-Bullock, Montreal.
P. R. Fisher, Conduit Elec. Mfg. Company, Boston, Mass.
George Gross, Electric Light & Power Company, Waterloo.
P. G. Gossler, Canadian White Company, New York.
J. A. Graham, Wahnapitae Power Company, Wahnapitae, Ont.
G. M. Gest, Contractor, New York.
F. Goodwyn, Midland Electric Company, Montreal.
Lawrence E. Gould, "Electric Railway Review," Chicago.
Nelson Grayburn, Montreal Street Railway Company, Montreal.
W. W. Grant, American Conduit Company, New York.
C. L. Glasgow, Allis-Chalmers-Bullock, Montreal.
A. Gaboury, Montreal Street Railway Company, Montreal.
W. C. Girard, Farnham Electric Company, Farnham, Que.
W. Girard, Farnham Electric Company, Farnham, Que.
R. Humphries, Babcock & Wilcox Company, Montreal.
A. P. Horner, Canadian General Electric Company, Montreal.
F. Hoffmeister, Canadian General Electric Company, Toronto.
George F. Haworth, Sadler & Haworth, Toronto.
Charles B. Hunt, London Electric Company, London, Ont.
George Hillyard, Mond Nickle Company, Sudbury, Ont.
Thomas Hillyard, Canadian General Electric Company, Halifax.
R. J. Hillier, Canadian General Electric Company, Montreal.
C. W. Hookway, Canadian Westinghouse Company, Montreal.
C. W. Henderson, Canadian Westinghouse Company, Montreal.
H. R. Hilchie, Canadian General Electric Company, Montreal.
R. F. Howard, Canadian Westinghouse Company, Montreal.
W. D. Hall, Canada Car Company, Montreal.
Professor L. A. Herdt, McGill University, Montreal.
J. Herbert Hall, Conduits Company, Toronto.
R. B. Hamilton, Packard Electric Company, St. Catharines.
E. L. Haines, National X-Ray Reflector Company, Chicago.
P. H. Hoyer, New York Insulated Wire Company, New York.
James Hutchison, Halifax Tramway Company, Halifax, N.S.
J. E. Hutchison, Ottawa Electric Railway Company, Ottawa.
H. U. Hart, Canadian Westinghouse Company, Hamilton.
W. Henrion, Canadian Westinghouse Company, Hamilton.
Frank T. Hodgins, C. W. Bongard Company, Toronto.
H. M. Hopper, St. John Railway Company, St. John, N.B.
Edwin Irving, Sunbeam Incandescent Lamp Company of Canada, Toronto.
S. Jomini, Jr., Laurentide Paper Company, Grand Mere, Que.
C. F. R. Jones, Wire & Cable Company, Montreal.
James Johnston, Public Works Department, Ottawa.
C. Walter Jones, Holophane Company, New York.
E. J. Jenking, Canadian General Electric Company, Toronto.
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Howard S. Knowlton, "Electrical World," Newton, Mass.
R. S. Kelsch, Consulting Engineer, Montreal.
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J. P. King, Stratford Gas Company, Stratford.
Herman P. Kimball, Standard Underground Cable Company, New York.
F. L. Kelsch, Chicago.
A. S. Kelsch, Montreal.
J. Kynock, Canadian General Electric Company, Toronto.
E. J. Kyle, Electric Light & Power Company, Merrickville.
S. B. Keys, Consolidated Car Heating Company, New York.
C. A. Lilly, Canadian General Electric Company, Montreal.
J. D. Lachapelle, Consulting Electrical Engineer, Montreal.
W. A. Lewis, J. A. Dawson & Company, Montreal.
John S. Lapp, Locke Insulator Company, Victor, N.Y.
V. R. Lansingh, The Holophane Company, New York.
T. Lynch, Allis-Chalmers-Bullock, Toronto.
George D. Leacock, John Forman Company, Montreal.
George Loring, National Elec. Lamp Association, Cleveland, O.
Major W. H. Laurie, Consulting Engineer, Montreal.
T. Lamb, Laurie & Lamb, Montreal.
Albert Laurie, Laurie & Lamb, Montreal.
A. B. Lambe, Canadian General Electric Company, Toronto.
Fred W. Miller, Canadian General Electric Company, Montreal.
D. M. McCargar, Belleville Portland Cement Co., Belleville.
E. Marcotte, Merchants' Telephone Company, Montreal.
A. F. Moray, Tweed Light & Power Company, Tweed, Ont.
W. L. Macfarlane, St. Lawrence Power Co., Cornwall, Ont.
Alister Maclean, Robb Engineering Company, Montreal.
Wm. McKay, Robb Engineering Company, Toronto.
D. McQuaide, Jr., Century Electric Company, Montreal.
E. D. McCormack, Canadian General Electric Co., Toronto.
William McCaffrey, Canadian General Electric Co., Toronto.
A. L. Mudge, Allis-Chalmers-Bullock, Montreal.
L. W. Morden, Canadian Westinghouse Company, Montreal.
D. C. Meloon, John Forman Company, Montreal.
B. G. McBurney, Canadian General Electric Co., Winnipeg.
J. T. Murphy, Canadian General Electric Company, Halifax.
Paul J. Myler, Canadian Westinghouse Company, Hamilton.
C. Martin, Canada Car Company, Montreal.
John Murphy, Elec. Engineer, Dominion Government, Ottawa.
James A. Milne, Allis-Chalmers-Bullock, Montreal.
H. A. Moore, Canadian General Electric Company, Toronto.
A. N. Mackay, Supt. of Town Works, Chatham, N.B.
R. H. Manwaring, Philadelphia Electric & Manufacturing Company, Philadelphia.
W. B. Morrow, Ottawa Electric Company, Ottawa.
J. J. Mackenzie, Winnipeg Electric Railway, Winnipeg.
A. Montabone, Canadian General Electric Company, Montreal.
E. G. Mack, Crouse Hinds Company, Syracuse, N.Y.
J. S. Maclean, Allis-Chalmers-Bullock, Montreal.
Hon. David MacKeen, President Halifax Tramway Co., Halifax.
J. M. McLennan, Light, Heat & Power Company, Lindsay, Ont.
W. H. Muirhead, Vernon Floor Dressing Company, Montreal.
W. H. Moore, Toronto Railway Company, Toronto.
B. T. McCormack, Allis-Chalmers-Bullock, Montreal.
C. H. Mortimer, Canadian Electrical News, Toronto.
F. C. Meads, "Canadian Machinery," Montreal.
William Needler, Light, Heat & Power Company, Lindsay, Ont.
J. M. Nelson, Jr., Fibre Conduit Company, Orangeburg, N.Y.
W. J. O'Leary, W. J. O'Leary & Company, Montreal.
George H. Olney, E. F. Phillips Electrical Works, Montreal.
Dr. R. B. Owens, McGill University, Montreal.
J. C. O'Brien, Eastern Can. Passenger Association, Montreal.
E. J. Philip, Municipal Lighting Plant, Berlin, Ont.
A. S. L. Peaslee, Canadian Westinghouse Company, Toronto.
George Philips, Wire & Cable Company, Montreal.
T. R. Price, Sunbeam Incandescent Lamp Company, Toronto.
F. J. Parsons, McDonald & Wilson, Montreal.
J. W. Pilcher, Canadian General Electric Company, Montreal.
J. W. Purcell, Hiram Walker & Son, Walkerville, Ont.
W. Phillips, Winnipeg Electric Railway, Winnipeg.
B. F. Reesor, Georgian Bay Power Company, Lindsay, Ont.
W. P. Roper, Canadian General Electric Company, Montreal.
W. H. Reynolds, Canadian General Electric Company, Montreal.
W. N. Ryerson, Ontario Power Company, Niagara Falls, Ont.
George C. Rough, Packard Electric Company, St. Catharines.
R. W. Robb, Robb Engineering Company, Amherst, N.S.
F. Rose, Canadian General Electric Company, Toronto.
Lacasse Rousseau, Canada Electric Company, Montreal.
Norman S. Richards, Canadian General Electric Co., Toronto.
Robert A. Ross, Ross & Holgate, Montreal.
Thomas W. Rolph, Holophane Company, New York.
W. E. Reesor, Light, Heat & Power Company, Lindsay, Ont.
R. N. Robins, Sherbrooke Power, Light & Heat Company, Sherbrooke, Que.
J. H. Rorke, Canadian Electrical News, Toronto.
W. J. Robertson, Consolidated Car Heating Co., New York.
Allan H. Royce, Canadian Street Railway Association, Toronto.
M. A. Sammett, Montreal Light, Heat & Power Co., Montreal.
R. J. Smith, Canadian Elec. & Water Power Co., Perth, Ont.
William T. Sutton, Canadian Westinghouse Company, Montreal.
Frank R. Schalek, "Electrical Review," New York.
C. C. Starr, Canadian Westinghouse Company, Halifax, N.S.
George W. Sadler, Sadler & Haworth, Montreal.
B. F. Selby, Canadian General Electric Company, Toronto.
George J. Stanley, Northern Aluminum Company, New York.
F. A. Sawyer, C. W. Lee Company, Newark, N.J.
Norman Stewart, Canadian Westinghouse Company, Montreal.
D. Sleeth, George W. Lord & Company, Montreal.
E. A. Seath, John Forman Company, Montreal.
E. F. Sise, Wire & Cable Company, Montreal.
H. F. Strickland, Canadian Fire Underwriters' Ass'n, Toronto.
H. H. Scott, Allis-Chalmers-Bullock, Montreal.
John H. Sloan, Corporation Electric Plant, Tottenham, Ont.
Thomas Stewart, Light, Heat & Power Company, Lindsay, Ont.
R. A. Stinson, Packard Electric Company, St. Catharines, Ont.
Paul F. Sise, Northern Electric & Mfg. Company, Montreal.

E. Smith, Gravenhurst Power & Light Plant, Gravenhurst, Ont.
W. Allan Staples, Cove Hydro-Electric Co., Fredericton, N.B.
Harley Selwyn, C. P. R. Freight Department, Montreal.
W. M. Skiff, Eng. Dept., National Elec. Lamp Association, Cleveland, Ohio.
Walter Sadler, Sadler & Haworth, Montreal.
Wm. B. Shaw, Montreal Electric Company, Montreal.
Irving Smith, R. E. T. Pringle Company, Montreal.
W. K. Sparrow, Fibre Conduit Company, Orangeburg, N.Y.
A. H. Sissons, St. Louis Car Company, St. Louis, Mo.
Leslie Show, Allis-Chalmers-Bullock, Montreal.
R. F. Schmitt, Montreal Light, Heat & Power Co., Montreal.
F. Thomson, Fred. Thomson & Company, Montreal.
K. B. Thornton, J. G. White Company, New York.

MR. W. N. RYERSON,
First Vice-President Canadian Electrical Association.

George W. Thompson, Light & Power Department, Westmount.
C. Thomson, Fred. Thomson & Company, Montreal.
A. F. Townsend, Cape Breton Electric Company, Sydney, N.S.
J. P. Thomson, E. F. Phillips Electrical Works, Toronto.
M. E. Tansay, Canadian Pacific Railway Company, Montreal.
W. Williams, Gas & Electric Company, Sarnia, Ont.
B. Welbourn, British Insulated & Helsby Cables, Prescott, Eng.
H. Webster, Electric Light Plant, Norwich, Ont.
W. McLea Walbank, Montreal Light, Heat & Power Company, Montreal.
J. J. Wright, Toronto Electric Light Company, Toronto.
R. M. Wilson, Montreal Light, Heat & Power Co., Montreal.
A. L. Woolf, Midland Electric Company, Montreal.
P. M. Walker, R. E. T. Pringle Company, Montreal.
Charles A. Walters, Napanee Lighting Plant, Napanee, Ont.
G. A. Wendt, Canadian Westinghouse Company, Montreal.
A. A. Wright, Renfrew Electric Company, Renfrew, Ont.
John J. Warren, J. A. Dawson & Company, Montreal.
H. W. Weller, Babcock & Wilcox Company, Montreal.
W. A. Walker, Montreal Light, Heat & Power Co., Montreal.
C. H. Waterous, Waterous Engine Works Company, Brantford.
G. M. Wight, Dominion Textile Company, Montreal.
Wayland Williams, Laurie & Lamb, Montreal.
P. B. Yates, Gould Storage Battery Company, Toronto.
T. S. Young, Secretary Can. Elec. Association, Toronto.
John J. York, St. Lawrence Sugar Refining Company, Montreal.
J. S. Young, C. Thompson, Limited, Montreal.

In opening the meeting the President spoke as follows:

"Gentlemen, if you will come to attention we will start the proceedings. I am sure we are all pleased to see so many members present at the opening session, although I understand that a good many trains have been a little late, and that a great deal of trouble has been experienced securing hotel accommodation. However, notwithstanding these difficulties we have more members present at this opening session than usual, which I think is a very good omen and bids fair for a good attendance at all the meetings. I will now call upon the Secretary to read the minutes of the previous convention."

The minutes of the last convention, at Niagara Falls, Ontario, were then read by the Secretary-Treasurer, Mr. T. S. Young.

The President: Gentlemen, you have heard the minutes of the last meeting. If there is no objection we will consider them approved. I think the Secretary-Treasurer is to be congratulated upon his report, as it is the fullest and most complete that we have yet had at a meeting of this kind.

This was agreed to and the minutes were approved.

The President: The next item on our program is the President's address. At previous conventions we have always had formal openings by the mayors and other local dignitaries, which took up considerable valuable time. We consider, however, that we have now become a sufficiently large body to hold our conventions wherever we please, and without being welcomed by any person outside our own ranks. As we have a somewhat strenuous program ahead of us, we will endeavor to keep up to schedule time and make things as brief as possible.

PRESIDENT'S ADDRESS.

GENTLEMEN:

It is with unusual pleasure that I welcome you to this the 17th annual convention of the Canadian Electrical Association. The aim of the Association is to gather together all members of the electrical fraternity and allied interests for mutual discussion, and to learn from each other's experience. The Association affords an opportunity for its members to become better acquainted and to exchange ideas. This can best be done by each member feeling perfectly at home, and taking part promptly in all the discussions which the papers bring forth.

By glancing at the program you will see that we have more papers than is our custom, but that they are of unusual interest, and by men capable of speaking authoritatively on the subjects presented.

We are fortunate this year in being able to hold our meetings at the home of the oldest Engineering Society in Canada, and we are deeply indebted to the officers of the Canadian Society of Civil Engineers for their courtesy in again affording us such a central and suitable meeting place. We are also fortunate in holding our convention at a large commercial and electrical centre, at a time when a special electrical exhibit is taking place, which in itself will draw those interested in electrical work from all parts of the country.

It is customary for the president's address to review the electrical progress for the past year, but to do this properly would require a report of considerable length, and be more or less of a repetition of what you have already read in the technical and daily press. I may, however, be permitted to touch briefly on several of the more important items of interest since we met at Niagara Falls a year ago last June. Since then the three large power plants we visited have been put into successful commercial operation, one having its 60,000 volt lines extending for over a hundred miles or so along the southern shore of Lake Ontario, supplying important commercial centres, as well as a large number of small towns and villages within easy reach of this transmission line. The second has its high tension line along the Canadian bank of the Niagara River, and supplies in conjunction with other power plants the needs of one of the most important cities on this continent, while the third has its 60,000 volt transmission line across the Niagara Peninsula, and extending along the north side of Lake Ontario, where it has a concentrated load (85 miles from the generating plant) at one of our large Canadian cities, which

MR. R. M. WILSON,
Second Vice-President Canadian Electrical Association.

is entirely dependent on this source for electrical power for its tramways, street, office, factory and house lighting, and the varied and numerous uses to which electrical energy may be applied. With the exception of some lightning troubles, these transmission schemes have been wonderfully successful, and we are advised that these troubles will soon be overcome by a new lightning arrester, which is now being perfected, and from which great results are expected. This is an achievement of which we as electrical engineers can justly be proud, as it means a great stimulus to all branches of electrical work.

The financing of these schemes has required more or less publicity which has aroused the socialistic propensity of some in the community, which has resulted in the most vigorous attacks on vested rights which we have ever experienced in an equal period of time. However, we feel satisfied that the worst is over and cooler judgment has superseded the first impetuous decision, that the only remedy for the situation was for the Government to duplicate existing investments.

While the campaign was at its height and agitators stirring up the public, we were told that Niagara power was as free as air. Had the author of this statement said it was as free as gold or as free as ice, we would have been more inclined to agree with him, as both of these commodities may be picked up and had free of charge at any season of the year in this extensive country of ours, but to deliver either of these to each man's door in small or large quantities so that he may be able to get just the amount he requires and have it on hand at all times costs considerable money—likewise electricity.

Power at Niagara Falls or any of our large water powers can be developed at very reasonable prices in large quantities, but it does not follow from this that the price to consumers in small quantities for intermittent use, one hundred miles or so from the generating station, can be supplied for very much less than the present figures.

In my opinion, the only way in which power may be delivered cheaply, and which we all admit is essential to the building up of our manufacturing interests and the welfare of the public in general, will not be by the Government or others duplicating existing investments, but by all working in harmony so as to develop the present plants to their utmost capacity and afford them a load as nearly uniform as possible for the twenty-four hours each and every day. Now that long distance transmission has been proved beyond a doubt to be commercially successful, and that large cities may depend entirely on it, the various generating companies will be extending their lines in the hope of getting a market for their entire development. Already plans are well under way by at least two of the large power companies at Niagara for extending lines throughout Western Ontario, so that it may be said that in a short time all electric power required within a radius of one hundred miles from Niagara Falls can be supplied from these large generating stations. If all this load was connected up, however, it would equal less than half the present development, and if power is to be cheaper it will be necessary that the entire investment be utilized, consequently it would seem that towns and cities outside this radius would have to be reached.

As A. C. transmission lines are expensive and do not lend themselves readily to supplying scattered districts, it is altogether probable that extensions outside the one hundred mile radius may be made on what is known as the Thury direct current system now in use in some parts of Europe, with direct current series generators and direct current series motors, which system is very similar to our present direct current arc lighting system, with which you are all familiar. By this system ten or more 2,000 volt machines could be driven from an A. C. motor, and connected in series; current being sent out on a single 20,000 volt wire and motors taken off in the same way as arc lamps are now connected, the return circuit being brought back by a continuation of this single wire, which is eventually brought back to the generating station. With this system, in order to stop a motor, it is only necessary to short-circuit the wires leading to it, the same as you would cut out a D. C. arc lamp on our present systems. If this system is adopted, small towns a considerable distance from the points reached by the A. C. transmission lines may be included. An outfit for such a town would consist of two or more 2,000 volt series motors which would drive line shafting and in turn drive the present plant or similar more modern machinery.

I mention this so that managers of electric plants considerably outside the present apparent Niagara field may commence now to prepare for eventually being supplied from some large generating centre. In order to do this you should carefully plot your combined load curve from day to day, so as to compare your summer load curves with your winter load curves, as the only way to get cheap power will depend not only on having a good load factor at the generating station, but on each transmission line, each sub-station, each local feeder and bank of transformers. When the large power companies are prepared to supply the smaller towns, they will expect them to pay on a flat rate of so much per horse-power per year, based on the maximum demand. In order for the local company to be able to pay on this basis, it will be necessary that the ratio of their average load over the twenty-four hours be high as compared with their yearly peak load. Careful attention to the load factor on each branch of any service is highly essential to the successful commercial operation of every electric plant.

For the past few years our country and people have enjoyed great prosperity, which has increased the demand for electric light and the demand on the electric plant generally. Great care should be taken to analyze the nature of each new consumer's load to make sure that his demand will be fairly uniform and not increase our capital expenditure for peak lighting business only, which would be the first to drop off should a reaction set in.

In conclusion the President said: I feel satisfied we shall have to get a great many new uses for electricity. The general tendency seems to be for much greater operating expenses, and with the high price of copper the fixed charges for distribution are going to be very much higher during the next five years than in the past five years, possibly with the exception of the last year. If these new incandescent lamps are used and our revenue cut down one to two-thirds of what it is now, and if wages keep up to the present high level, all this, combined with the high price of copper, will make it highly essential that we develop new uses for current. It is surprising what can be done in this connection by energetic canvassing and getting electric light used for sign lighting, advertising, decorating, etc., and what can be done in the way of extending the use of electric heat.

I had the pleasure recently of meeting a gentleman from Germany connected with a very large electrical company there, and he told me that in Germany they look upon the electrical heating field as much more important than the lighting field, because they find that the revenue from the heating field is better and more steady than that produced by the lighting business.

Now, as we have to extend our areas, it would appear to me to be wise that we should also consider the advisability of raising our voltage, because if we doubled our present 110 volt system to 220 volts, we would be able to transmit current four times the distance we now can, and thus cover sixteen times the area, which would be very beneficial in getting in new load. I will now leave these thoughts with you at the opening of this, our seventeenth annual convention. (Loud applause.)

R. G. Black,
President.

The President: I will now call up the Secretary-Treasurer to read his annual report.

SECRETARY-TREASURER'S REPORT.

I take pleasure in presenting my annual report, covering the fiscal year of the Association ending May 31st, 1907.

The clerical work arising out of the last annual convention was executed as promptly as possible.

In accordance with the suggestion of the retiring president, Mr. A. A. Wright, M.P., and by direction of the Executive Committee, a bond was duly furnished by your Secretary-Treasurer for $1,000.

There were published 700 copies of the Proceedings of the Convention, and 500 copies of the Question Box, one of each being furnished to all members. The balance has been distributed, as far as possible, with a view to securing new members.

By resolution of the last convention, the Executive Committee was instructed to make such amendments to the constitution as might be found advisable. The matter was placed in the hands of a special committee, and the revised constitution as

submitted by this committee was approved at an Executive meeting on August 30th last, at which the Secretary was instructed to have the new constitution printed and distributed at this convention.

In compliance with the unanimous wish of the Executive, and I believe of the members also, Mr. A. A. Dion consented to continue as Editor of the Question Box for another year.

To avoid the necessity of Executive meetings, considerable business was transacted by correspondence, such as the passing of accounts and acceptance of applications. The first meeting of the Executive since the last annual convention took place on March 13th last, at which it was decided to make a departure this year and hold the annual convention in September instead of June, concurrently with the Electrical Exhibition in Montreal. This decision was obviously in the best interests of the Association.

The question of procuring papers for this convention was left in the hands of our first vice-president, Mr. R. S. Kelsch, and to him belongs the credit for the splendid program of papers to be presented. The appointment of a Local Committee was also left with Mr. Kelsch.

Mr. L. W. Pratt having severed his connection with the operating business, tendered his resignation as a member of the Executive Committee. Mr. R. M. Wilson, superintendent of the Montreal Light, Heat & Power Company, was elected to the vacancy.

The following Committees on Legislation were appointed:—For Ontario—Messrs. J. J. Wright, Toronto; C. B. Hunt, London; A. A. Dion, Ottawa; R. S. Kelsch, Montreal; W. Williams, Sarnia. For Quebec—Messrs. W. McLea Walbank, Montreal; R. S. Kelsch, Montreal; George H. Montgomery, Montreal; E. A. Evans, Quebec, and R. N. Robins, Sherbrooke, with power to add to their number.

Membership.—The membership of the Association on May 31st, 1907, was 302. This would appear to be a decrease as compared with the previous year, and a few words of explanation may be permitted. Until last year no steps were taken by the Executive to remove from the membership roll the names of persons who, although neglecting to send in their written resignations as required by the constitution, evidently did not consider themselves bona fide members of the Association. The adoption of a less generous policy by the Executive resulted in the removal of a large number of names from the register. That the Association has made substantial progress, however, is shown by the fact that 62 new members joined during the year, and 28 members from May 31st to August 30th, or a total of 90 new members since the last convention. The present membership is 320.

The geographical distribution of the membership on May 31st was as follows:—

Ontario	184
Quebec	76
Maritime Provinces	5
Manitoba, Alberta and Saskatchewan	8
British Columbia	7
Yukon	1
United States	21
Total	302

Dues.—The dues collected during the year amounted to $942, which included $171 owing prior to the year 1906. The expenditures totalled $937.70.

During the year ended May 31st there were issued from the Secretary's office upwards of 550 communications, in addition to letters accompanying accounts for dues.

Hereafter the Annual Proceedings will be published in smaller size, corersponding to the proceedings of other technical societies, the Managing Committee believing this to be a more convenient form.

While the Association has collected no statistics, it is evident that the use of electricity in Canada is becoming much more general. The power load has in late years become an important factor in the income of the central station, and the attention which is now being given to electric heating and cooking suggests another field of no small proportions. Fortunately, the first paper on our program will describe some of the various devices for this purpose.

According to the report of the Electric Light Inspection Branch of the Inland Revenue Dpeartment for the year 1906, there were in Canada 368 central stations controlled by private companies and municipalities, operating 16,205 arc lamps and 1,828,507 incandescent lamps, or, estimating one arc lamp as equal to ten incandescents, a total of almost two million incandescent lamps. When to this is added the large number of isolated plants, by which is meant plants not doing a commercial business, some estimate may be formed of the consumption of electric light. It may be of interest to know that in five years the increase has been one hundred per cent.

With the growth of the electrical industry, the membership of the Canadian Electrical Association should continue to increase. As your Secretary, I shall be glad to receive suggestions as to how the Association may become more helpful to its members, and also to carry out any instructions of the Managing Committee to that end.

Respectfully submitted,
T. S. Young,
Secretary-Treasurer.

The President: Gentlemen, you have heard the Secretary-Treasurer's report. Is there any comment? If not, we will declare it approved.

This was agreed to and the report unanimously adopted.

The President: The next item on the program is the consideration of reports. Have any committees any reports to make?

The Secretary: I think not, Mr. President.

The President: Then we will go on to the next item of business, the adoption of the new constitution. According to the minutes of the last convention which you heard read a few minutes ago, the Executive were authorized to get up a new constitution. The old constitution was found to be inadequate and it was considered that the Canadian Electrical Association had outgrown it, and that we were not able to live in accordance with it. The Executive therefore appointed a committee to look into the drafting of a new constitution. This constitution was very carefully drafted and submitted to the Executive, which also considered it carefully and revised certain of the articles and made changes, after which it was again referred back to the committee. The final draft was submitted and approved by the Executive on August 30th last. As, however, it would take considerable time to read it all now I would suggest that some person move that the reading be dispensed with and that Messrs. J. J. Wright and B. F. Reesor move the adoption of the constitution.

Messrs. J. W. Purcell and W. N. Ryerson moved that the reading of the constitution be suspended, which was unanimously agreed to.

Mr. J. J. Wright then moved, seconded by Mr. B. F. Reesor, that the constitution as submitted be adopted as the constitution of the Canadian Electrical Association.

The President: Is there any objection to this? If not, we will declare it carried.

There being no objection, the motion was unanimously adopted.

The President: Is there any other business before we start our regular program of papers? There being no other business, we will now proceed with the program. As we have a rather strenuous program and a good many papers to go through, and as I have no doubt that they will all bring forth considerable discussion, I would suggest that each member who wishes to discuss papers do so promptly. I have now much pleasure in calling upon Mr. A. B. Lambe, who as you all know is connected with one of our largest manufacturing companies and has given much attention to the details of electrical apparatus as Engineer of the Supply Department of his company. We will now ask him to present his paper, entitled "Electric Heating and Cooking Devices."

ELECTRIC HEATING AND COOKING DEVICES.

By A. B. Lambe.

Mr. President and Gentlemen:

It naturally gives me a great deal of pleasure in having an opportunity of appearing before you this morning, because I appreciate the honor of the invitation; I do not propose to keep you very long with the paper itself, but I sincerely trust that what I lay before you will prove of interest and value, and that you will discuss the subject very fully and freely because, after all, the discussion is the real essence of any such meeting as this. You need have no diffidence in discussing the question to almost any length, because heat is one of the most universal phenomena with which we have to deal, appearing, as you will at once admit if you reflect for a minute, in almost every one of the multitudinous actions which go to make up our daily lives.

When one comes to lay down on paper a few thoughts concerning the electric production of heat, and its utilization, about the first thing that strikes one is that it presents several very curious situations. Perhaps the first of these is that in electric heating and cooking material designers we have a class of men who are struggling hard to produce what has hitherto been the bane of all other electric men, viz., heat. All other designers, manufacturers, and operating men, have been endeavoring, and of course are still so doing, to put as much electric energy as possible into a given piece of apparatus and to transform it into either light or motion with the production of as little heat as possible, and further, to dissipate what heat they do produce as quickly as they can get rid of it. As opposed to this heating men try to get as much heat as possible from as little electrical energy as possible, and then when they have got it they use their utmost endeavors to conserve it and keep it within the apparatus in which it was generated.

Fundamental Laws.

Before we go into any details concerning the actual apparatus it seems desirable to touch on some of the fundamental laws governing the phenomena concerned. About the first of these is that relating to the actual production of electric heat, the theory on this point being that the current in passing through a conductor simply agitates or disturbs the molecules which compose that conductor, and in moving one on the other they produce friction, which shows itself outwardly in heat. This is a very simple and elementary statement of the theory, and please note particularly that it is only a theory. We do not know definitely what the action is, we simply imagine we know, and so the statement of the action which we imagine takes place has to be called a theory.

Along with the production of heat we frequently have also the production of light and motion, the three phenomena being more or less closely related. Light, however, scarcely enters into the electric heating and cooking question, except in the case of the luminous radiators, because you do not run your conductor up to the point of giving light—if you tried to it would be destroyed long before you reached the light emitting temperature. Motion also comes in but slightly, though still you have to guard against it a little, otherwise the expansion when you put a device on the circuit, and the contraction when you take it off and it cools down, would cut through the insulation or break the conductor.

Now this heat once produced instantly starts to flow in an endeavor to equalize itself, and here you strike a second very curious phenomenom in connection with our subject, which perhaps can best be illustrated by reference to the actions in water, etc., as follows, viz.: Assume that you have a flow of water in a pipe, the instant you close a valve the flow stops, electrically a similar action would be a flow of current in a conductor, the instant you open the switch the flow stops. But in working with heating materials you have no analogous action because you cannot absolutely stop the flow of heat; perhaps the point, which is most curious, never struck you before, but if you think for a minute you will see that it is true. For example, take a radiator and embed it in asbestos or blankets or anything you like, it will not keep hot right along unless you keep it supplied with fresh heat, put ice in a refrigerator with no mater how many walls, or one refrigerator within another, still the ice will melt after a while. Thus we have the curious fact that you cannot absolutely stop the flow of heat, though it can be retarded or it can be accelerated within quite wide limits.

Heat flows or equalizes itself in three distinct ways, viz., conduction, convection, and radiation.

Conduction, to explain it shortly, is the passage of heat between the adjacent particles of any given mass or between contiguous masses, that is, those which are touching each other. You can remember that more easily by taking the Latin root of the word, i.e., ducto, to lead, it is practically heat led from one place to another. Another electrical word that has the same meaning is conduit: conduits originally were secret underground passages between buildings, and because they were secret and dark you had to be led through them: conductor also comes from the same root.

Convection is the transference or equalization of heat by means of movements from one place to another of the atoms which contain the heat: that is, the heat is actually carried from one spot to another. You perhaps will understand this more easily if I give you as an illustration hot water or hot air heating of houses. The actual water or air, which has heat put into it in the furnace, moves up through the pipes to the room to be warmed, carrying the heat with it. Another aid to remembering the action is the root, viz., vecto, to carry, our ordinary word convey coming from the same source.

Radiation is the passage of heat through that matter which surrounds the earth, called the ether, by waves, very similar to the phenomena of light and sound waves.

Parts of Devices.

There are naturally very many ways in which these natural laws can be made available for the production of commercial devices, but we find that, no matter what forms the various articles may finally assume, they all consist broadly of three distinct parts, namely, the body, or the vessel in which the work is to be performed, the conductor, and the insulation. It will be interesting to look for a minute at the materials composing these different parts.

For the body we have iron as a very favorite metal, I suppose because it is cheap and can be readily obtained: we have men who know how to handle and work it, and it is strong. We find also that copper is extensively used, for the reasons doubtless that it is hygienic, it is lasting, and has a good name; a solid copper article is as a rule a good article. Aluminum is also used extensively because it also is hygienic, being clean and untarnishable: further, it is what is called an unctuous or greasy metal, and therefore things do not stick to it. This is a very valuable property for heating devices, an artificial reproduction of this natural characteristic being the familiar household operation of greasing cake tins. Another valuable property it has is that of conducting heat quickly. You know that substances vary very much in this regard, just as different materials have different current conducting capacities, hair, felt, wool, asbestos, etc., etc., all being poor heat conductors, or perhaps it would be more correct to say that it is not the materials themselves so much as the air cells they contain, still air being a very bad heat conductor. You have often noticed a bird ruffling up its feathers in cold weather: it is simply taking advantage of the same natural law and is keeping its body heat in as much as possible by interposing between it and the outside air the several layers of still air thus produced. Silver, as opposed to the materials enumerated above, is a very good conductor of heat, and so likewise is aluminum, both being very much better than iron.

For the conductors also we find iron used extensively, not pure iron, but iron as the main basis of alloys containing zinc, copper, nickel, etc., and sometimes combinations of these without any iron. The reason for using these alloys is two-fold, first, to get the increased resistance of the other metals, secondly, and perhaps more particularly, to obtain their non-corrosive properties, because commercial iron by itself, especially when alternately heated and cooled, is far too corrosive to have any life worth speaking of.

When we come to consider the insulation we find another very curious point, and that is that all the old original materials which have done such good work in other electrical apparatus, and for that matter are doing it still, are no good in heating devices. I refer of course to the fibrous materials

like cotton and wool, to the asphaltic compounds, and to rubber etc., etc., these all being so inflammable that they are impossible for heating devices. In view of this the designers of electric heating materials are forced to rely entirely upon mica, asbestos, porcelain, and some of the enamels.

Different Designs.

Just as there are many materials available for use in heating goods there are many ways of combining them: it will perhaps pay us to glance over the main designs:

Taking one of the main forms first—the cast iron grid type —we find that it is very popular for a great many articles, particularly for air heaters of large sizes. A point to be specially noted is that it is not suitable for the smaller devices, because of the difficulty of casting very small grids, the dividing point being somewhere in the neighborhood of 20 amperes.

Then you have the almost universal spiral wire form of heater, supported either on the ends, the centre being free, or else wound on an insulated mandrel.

Then there is the somewhat peculiar construction used in Prometheus designs. This company takes a mica plate as a basis, puts a binder upon it in the shape of a gum, and on that pastes or sprinkles the actual conductor, which is a mixture of powdered platinum and gold. Over that is another sheet of mica, the whole being bound inside of two sheet iron protecting plates.

Then we have a construction peculiar to the Simplex Company, namely, the embedded enamel form. The process for making this is to take the body, which is always cast iron, sprinkle it with an enamel powder, just as in making ordinary enamelware, and heat it until the powder melts, this being repeated several times until you have a good coating of enamel on the inside of the vessel. Then the conductor, which has been previously wound into a form that will fit the body, is put in place, more powder sprinkled over that, and the heating process repeated until you finally have the conductor embedded in a solid layer of enamel, which, in addition to being both an insulation and a support, also serves to keep away the air from the conductor. The object of this latter is to allow you to run your conductor at a higher temperature, which means that you can then use a smaller conductor than would otherwise be necessary, which in turn means a smaller, cheaper, and neater device.

The American Company use the wire wound form a great deal, and they also employ the ribbon conductor, embedded in mica and bound up tightly in iron plates, the idea of the iron being to get mechanical rigidity and also increased radiating surface.

This sample (Mr. Lambe had previously passed around to the meeting various heating units, showing the inside construction of the different types detailed above) shows the form employed by the Pacific Electric Company of Vancouver. It consists of a metal centre covered with a mica sleeve, the wire conductor being wound on top of that. You will notice, from the above samples, that electric heating devices have yet another peculiarity, and that is that the use of solder is absolutely impossible, this being due of course to the high temperatures which the majority of the devices attain. All joints have to be either twisted or brazed, or else made with binding screws.

Then the General Electric Company has two distinct forms, the quartz enamel and the cartridge unit. The quartz enamel design gets its name from the insulation employed, which is powdered quartz, held in place on the bottom of the vessel by a sticky enamel. The conductor, which is a wire spiral, is insulated between turns and on the underside with mica. This water cup, which has been cut in two after assembly, will show the construction very clearly. (Sample passed around.)

The other form of the G. E. Company, the cartridge unit, gets its name from the shape of the heater, which is very much like a cartridge, and, being easily separable from the rest of the article, can be called a unit by itself. It consists simply of a wire which is first flattened and then wound on edge into a long coil, being insulated between turns by a compound in which it is dipped. After this it is baked to drive out the moisture, then, when it has been put into the case, from which it is insulated by a mica sleeve, and the terminals and porcelain cap have been put on, you have the completed article. It is interesting to note, in connection with this construction, that it was discovered more or less accidentally, the design first being developed in connection with arc lamps. When used in that class of goods it showed such magnificent heat resisting qualities that it was finally incorporated in heating materials.

Another more or less novel construction, and one which I thought would therefore be interesting to you, is that employed in heating pads. The basis or starting point is a braided asbestos rope, the conductor being wound on this in the shape of a spiral, with quite a large space between turns. On top of this comes a layer of asbestos braid, the whole being then sewed up in a cotton body, after being coiled to a shape in which you ordinarily see it. To prevent the temperature rising beyond a safe limit there are two thermostats inside. These open when the temperature rises to a certain point, and close when it falls below: thus the heat is regulated automatically and the device can be left continuously on the circuit without danger of fire. This sample (passed around) which you will see has been partially dissected, will give you a clear idea of the construction.

Various Articles Made.

Now to run over for just a few moments some of the various electric heating articles made, we find on the list such things as coffee percolators, a device used extensively in the States, though not to the same relative extent over here; chafing dishes, of which the same thing is true; stoves; water heaters; ovens; grids; heating pads; frying pans; flat irons; air heaters; shaving mugs; curling iron heaters; complete cooking outfits, etc., etc., in fact for almost every household operation which uses heat there is an electric device to do the work, besides which there are a great number of commercial designs.

In this connection I should like you to note two or three special points, the first being that in the electric air heater we have an article of 100 per cent. efficiency. This you will instantly recognize is another very curious point, pertaining, I think I am correct in saying, to practically no other action nor device. The reason of course is simply that the heat, which in other electric devices strays off into the air and is therefore lost, or in other forms of air heaters goes up the chimney in the form of smoke, etc., is in the electric air heater not lost because it goes to do that for which the article is designed, viz., it heats the air. Perhaps the point will be clearer if you compare this device with some of the others, say for instance a coffee percolator. A large part of the heat developed in this latter of course goes into the work which you want done, viz., the heating of the water in the vessel, but at the same time part is radiated into the surrounding air, and as the heating of air in this case is not what you want to do, this radiated heat is a direct loss; therefore you have a device of less than 100 per cent. efficiency.

Secondly, I would like to point out to you that the household devices divide themselves more or less naturally into two distinct classes, viz., those which can be connected to an ordinary socket, and those which require special wiring. Strictly speaking, I suppose that nothing larger than about 200 watts should be taken from a socket, at any rate if it be of the key form, though as an actual matter of fact devices taking 600 or 700 watts will operate from any ordinary socket or receptacle with perfect satisfaction. This applies to 110 volt circuits, or in other words to loads of about say 6 amperes or less, if the circuit be 220 volts the allowable wattage can be practically doubled, though you must understand that no key socket will open that load.

I have not thought it desirable to detain you with any detailed description of all the various articles, nor to show you samples of complete devices, because you will have an opportunity of seeing them all at the Electrical Exhibition, where there are several splendid collections in operation, and so as time presses we will leave the electrical and mechanical ends and turn to the commercial side.

Advantages of Electrical Forms.

Naturally the first question that now arises is, what advantages can we claim for electric heating devices and how can we get them out on our circuits. The answer to this is that their advantages over the present methods of doing the work

viz., coal and gas heating, are those of convenience, cleanliness, safety, and, in the commercial field, a better product and more of it. We will come later to the best method of introducing them to our customers, but taking up the first of the foregoing items you will see that convenience can be illustrated in a very forcible manner by the luminous radiator in such situations as drawing rooms, sitting rooms, offices, etc., where a little heat is very frequently needed for but a short time and on very short notice; the electric radiator here fills the bill to perfection. Then take the same article in bath rooms, particularly where there are children in a house, obviously it is almost the acme of convenience to be able to get instantaneous heat here at any hour of the day, particularly in the summer when the furnace is out. Then you have such things as hot water heaters, which are most valuable for giving small quantities of warm water during the time that the kitchen range is not running, stoves on the dining room table for giving a continuous supply of hot toast just as it is wanted, coffee percolators right on the table for breakfast or up in the sitting room for supper, flat irons upstairs in the sewing room right beside the work, to say nothing of those in the kitchen, saving an immense amount of running to and fro between the dining table and the stove, the sitting room and the kitchen, etc., etc.; these all illustrate the same point. Then as an example of convenience in commercial work you can offer the soldering iron or the glue pot, both of which can be brought right beside the work, besides which in them you have devices that stay at a nice operating temperature all the time, instead of first being too hot and then the next instant being too cold. This matter of convenience is particularly true of glue pots because, as the Underwriters frequently will not let gas be used, steam heating then becomes the only alternative to electric operating. Steam heating, when you get it installed and running, is very nice, but it is very frequently a most difficult matter to carry steam to a distant point in a large factory, and besides that, when you get it there the location of the pot is fixed at the point where you place the table. As opposed to this, electric wiring can be conveniently run to any point, and after that you can use an extension cord so as to bring your glue pot directly beside the work, a most valuable feature.

Then, turning to the point of cleanliness, you will see that in this respect electric devices have every advantage because, there being no open combustion, there can be none of those products which with both coal and gas are frequently so much in evidence and so distasteful, viz., soot and other deposits on the outside of the utensils, besides those bye-products which come off in the form of gases and vitiate the air. Then you have cooler kitchens, a most desirable point, and less fire risks. I say this latter not because I know of any exact figures on the subject, but simply from the comparison between electric lighting and other illuminants; statistics on this subject show that the fires from electric lighting are several times less than those from all other lighting devices put together, and I see no reason why the same thing should not be true with regard to electric heating and cooking.

In commercial work, as another advantage, you secure a larger amount of work from a given equipment, together with improved quality. In this connection I quote you a letter from a laundry down in Martin's Ferry, Ohio, Mr. Wilson, the proprietor, writing:

"... the time consumed in getting hot irons from the gas or other stoves and the cooling them off soon pays for the extra expense installing the electric heated irons; furthermore, the work done by the electric irons is all of one lustre and finish. Again, our girls are doing 20 per cent. more work than before."

and from another laundry, I think this one is down in Atlanta, we have the statement that by the use of electric irons, the former equipment being gas, 30 per cent. more work can be done by each operator per working day.

Cost of Operating.

So much for the advantages, now for the disadvantages. Well, when you turn to this side of the question you will find only one point to fight, only one argument used against you, everything else being conceded as in favor of the electric proposition, and that is cost, this cost dividing itself into two distinct items, viz., the first or capital outlay, and the operating expense.

The only way to approach the question of cost is to say, and in saying it to feel yourself that it is absolutely true, that the advantages will to a tremendous extent outweigh this disadvantage and make the proposition very attractive to a great many of your customers. In this connection you will see if you think of it for a moment that you have a very good guide behind you in our experience with electric lighting. When people used coal oil lamps it was because they could not get anything better, and when they could get a gas service they almost invariably turned to it, notwithstanding that it cost more. Again, just the same thing showed itself true with respect to electric lighting which, when it becomes available, is eagerly embraced by innumerable of those who hitherto were using gas, notwithstanding that it is still more expensive; in other words the benefits resulting from less work, from the absence of dirt and smells, and its greater safety, have made electric lighting supersede to a very great extent all the other illuminants, notwithstanding that, as a rule, it is the most expensive. The same thing is being found true of electric heating and cooking as far as it has been introduced, and without doubt the future will still further prove the principle.

Now as to this cost question, is it really as big a bugbear as unfortunately we think it is? To get an answer to this question we can only look to actual experience, and to get that experience we must go to the States because, though possibly Europe is ahead of this continent in most electric lines, our neighbors to the south probably lead the world in electric heating and cooking. Well, as a result of many experiments carefully made and accurately tabulated it is found that it takes about 300 watt hours per person per meal for complete electric cooking. Taking this as a starting basis we find that, using the Toronto lighting rate of 8 cents, complete electric cooking for a family of five would cost \$10.80 per month, or at a 5 cent rate \$6.75. (Please understand of course, when I give you these figures, that they are averages and that individual experiences will vary quite widely both ways.) The corresponding cost for coal at prevailing prices would be about \$7 per month, and with gas at \$1 the cost would be about \$3 per month. From this you will see that, to compete with coal at about \$7 per ton, current must be sold at about 5 or 6 cents per kilowatt hour, and at about 3 cents per kilowatt hour if you are to get your cost down to that of gas at \$1 per 1,000 cubic feet. These figures of course take account of nothing but actual cost, leaving out of the question all the incidental advantages mentioned, which belong exclusively to the electric method. As an example of complete electric cooking I would instance to you the territory surrounding Cincinnati, in which there are about thirty complete electric cooking outfits, and from which district it is reported that the monthly bills run from \$3 to \$6 per household. I do not know the average number of people served by each outfit nor yet the rate, but imagine the latter would probably be 5 cents and that there would be as a rule five or six people in each house.

Methods of Handling and Introducing.

Now please remember that these figures cover complete electric cooking, which is the extreme of the proposition, particularly to us who are just commencing to investigate it, and therefore the question naturally arises as to the best way of beginning, that is, how can the devices be introduced? Here again we must look to the States for our guidance.

Their experience shows, first of all, that central stations must, in the beginning at any rate, handle the devices themselves, because they only are in position to advertise and demonstrate them to the necessary extent. If, later on, when the business has become established, you desire to drop out of it and leave it entirely to the dealer, you can do so without difficulty. Secondly, you should resell the articles as nearly as possible at cost, this in order to reduce the first part of the expense to the customer, viz., his capital outlay, because while this is not by any means the controlling factor in the situation, it is still a not unimportant point. In establishing this latter procedure you again have very good previous experience from the lighting field to guide you, namely, the free renewal of incandescent lamps, where it has been established without question that your best returns should be looked for, not from the sale at a profit of the apparatus itself, but from the current which it consumes.

When we come to consider what article it is best to offer

first we find that the flat iron is used almost universally as the entering wedge. I suppose the reason for this is that it is one of the most common household articles which we have, that it is comparatively cheap, and that it is a device in which the advantages of cleanliness, convenience and decreased work can be shown with great facility. In this connection I would say that one might talk for a whole day on these points alone and still not be able to give you anywhere nearly as good an idea of how much these advantages really mean to a household as can be got from an hour or so's actual use of the iron itself. Therefore I commend to your careful consideration the proposition that if your own homes are not already equipped with electric flat irons tnat you make the change immediately, your households will be simply delighted with them, and you will be astonished at tne interest they will create among your friends and the number oi inquiries which will arise therefrom.

The companies in the United States which have been exploiting heating material have all taken the one course of introducing it, viz., by sending round a demonstrator, with a sample, to go into every house which has an electric service and show the actual way in which the iron counects to the socket, how it is used, and generally what a nice article it is. Then the offer is made to let that household have an iron for trial, without any cost other than paying for the current which it may cousume, for one, two or three months, as they may elect. They are not asked to pay anything until they say finally that they will keep it. This general principle of course is varied more or less in different places, some companies preferring to send out about a hundred irons at a time in a wagon with a demonstrator, others thinking it better to let the wagon follow a day or so after the demonstrator has been around, calling only at those houses which have agreed to take an iron on trial, but in the end the main principle is the same. In addition to this method the ordinary ways of selling goods should of course be used freely, viz., advertising both in the local press and by means of flyers put in with your invoices, samples constantly in view in your office, and occasionally a demonstrator there for say a week at a time showing how they are used. Besides this quite a number of the larger United States lighting companies issue monthly bulletins which are devoted to a description of the many electric household devices which are on the market, the heating and cooking line always being kept prominently to the front.

Rates.

Now as to the question of rates, we find as a rule that for that class of devices which goes on to the ordinary house wiring no special rate is given, the same price being charged as is collected for lighting. For the larger apparatus which requires special wiring we find that usually special rates are offered, particularly for complete electric cooking or any extensive heating, some of the figures being as follows:

In Jackson, Mich., a city of about 25,000 populatiou, they have a 5 cent rate.

Hartford, Conn., which by the way is a very advanced electric city, gives a 3 cent rate, their regular figure being 10 cents.

Schenectady, with a population of say 40,000, gives a 5 cent rate.

Sault Ste. Marie, Mich., has the extraordinarily low rate of 2 cents, though in this connection it must be remembered that they have a very large water power right inside the city limits, so that their transmission costs are practically eliminated.

I am glad to be able to add to the list a Canadian city, viz., Montreal, where they are quoting 5 cents for cooking and heating services.

Some Results.

Lastly, I think you will be interested in learning some results which have been obtained from the foregoing methods, and I would accordingly give you the following illustrations, viz.:

In Cleveland the Cleveland Illuminating Company, by using demonstrators from house to house, and in their own show rooms, put out 1,200 heating pieces in the twelve months ending December, 1906. They then stopped their active demonstrating campaign, feeling that the goods were pretty thoroughly introduced, which view was apparently quite correct, as they report that their output is still increasing, now averaging about 120 pieces per month. I said that they have stopped their demonstrators, out this is not strictly true in that they still continue that practice with respect to complete cooking outfits. If you are a prospective customer for one of these all you have to do is simply advise them of the fact, when they will send a complete equipment to you right away, and with it a chef who will stay in your house for a week and cook all your meals, all without any cost other than that of the current consumed.

In Massillon, Ohio, and I am glad in this connection to be able to quote to you some smaller places, as they are more interesting to us than the very large cities, they had a demonstrator out for several weeks. Just think of it, a little town, because Massillon has a population of only 11,000, putting out demonstrators on heating goods, and with satisfactory results too, because the Massillon people found that the business paid them so well that they now have a permanent solicitor. Can you see any reason why you should not do likewise?

As another example I would quote Rochester, N.Y. Of course Rochester is not a small city, the population being 175,000, but it is essentially a gas field, as I understand that until very recently they had only some 700 houses wired up. They also put out a demonstrator temporarily and his results were so gratifying, viz., sales of approximately $1,000 for the first month, that he is now with them permanently.

Greenville, Ohio, with a population, just imagine, of only 5,000, also put out a demonstrator. His appointment was temporary, of course, as nobody could expect that there would be room in a place of that size for a permanent man, but the point I want to bring to you here, in addition to the fact that a place of only 5,000 put out even a temporary representative, is that they report that of all the material left on trial they got back something less than 5 per cent., which is probably a fair average experience. Furthermore, they state that the flat irons are bringing them in a revenue of about 50 cents per month. This is probably a little below the average, because if you start and figure the number of hours which an iron may be expected to be in service, you will find that at a 10 cent rate it comes somewhere in the neighborhood of $15 per year. This is probably a little optimistic, but experience in other places shows that you can figure on a return of at least $10 per iron per year.

Then I want to instance to you our own city of Toronto. I am sorry to say that this is not an electric example, but I give it to you just to show that the question of first cost is not nearly as serious as it is frequently thought to be. In that city quite an active campaign has been carried on by the Ruud Instantaneous Gas Heater people, who I understand have quite a nice device, and who tell me that as the result of about six or seven months' work they have 25 outfits in operation. Now the smallest of their devices costs exactly $100, from which you can see that there are plenty of people ready to expend quite a large amount of money for quick and clean service involving the minimum of labor. If anybody can show this in connection with gas devices surely it is a comparatively easy proposition when you start to demonstrate electric material.

In Schenectady, N.Y., a city of some 40,000 popuulation, they have about 1,500 irons in operation, besides 30 complete cooking outfits, all as the results of samples left for trial after a visit by the demonstrator.

Spokane, Washington Territory, has several thousand irons in use, though there they departed very materially from the conventional method of introducing them, the lightiug company giving them away in connection with one of the local newspapers as a premium for every year's subscription to the paper with which they made the arrangement. You will of course admit that the idea was very novel and one which perhaps would not appeal to our more conservative tastes, but it seemed to work very satisfactorily in this case.

Los Angeles, California, a city with a population of 100,000 people, has 10,000 irons in use, or one for every ten people, which you must admit is an extraordinary record. It is the result of persistent demonstrating, some 7,000 irons having been put out on trial.

This list could be multiplied almost indefinitely, but I find that I am taking too much of your time, and consequently must come to a stop. Permit me only to say in conclusion that I hope you will realize from what has been laid before you that electrical cooking and heating devices offer a tremendous

field for the increase of your load. More than this, they will not only build up your load, speaking generally, but they increase that particular part of it which you are naturally most anxious to see grow larger and larger, viz., your day load. Remember what our President said to us in his opening remarks about heating devices in Germany, if you will reflect, you will recollect that he did not say that the income from them was more than from lighting, but that they were looked upon as of more value than the lighting load. I think the point he had in mind was that they are essentially a day load.

DISCUSSION.

The President: Mr. Lambe has given us a very interesting lecture upon heating and cooking devices, which are comparatively new features to most of us in this country, as up to the present we have not given very much attention to it. I am glad he touched upon the commercial side of it, as the commercial side of any electrical proposition is always extremely interesting. There is an advantage in the use of electrical cooking and heating devices for the household, as our mains and transformers for a large portion of the year are idle in the day time, and by cultivating this field we would get a revenue from investments which at present are idle except for but a few months of the year. Take the ordinary house lighting transformer—it is practically unused in summer except between nine and ten or eleven o'clock at night. Coming on to the fall and winter it is used for probably five hours out of the twenty-four, so that if it is used in the morning and afternoon for ironing or washing, etc., you would get a revenue from investments which would otherwise be lying unproductive.

In connection with this the two-rate meter could be used to great advantage, so that we would get the maximum lighting rate for the lights and possibly a lower rate for the current used during the day time. I am sure Mr. Lambe has much valuable information which we all want to hear, as this is a subject on which we want to know more, and I will now leave this question in your hands to ask Mr. Lambe any questions you like.

Mr. Purcell: Is it not true that the granular form of heater has been extensively developed in Germany? I saw an account of it some time ago, but do not know whether it is used commercially or not. It seemed to be very successful and showed characteristics different from those of the devices used in this country, and I would like to hear about them. Speaking about heaters, I have a number of them in use, one for furnishing sealing wax for sealing barrels. We found that with a water heater you had to buy a heater which was designed for a higher voltage, and we had a number of them burn out before we found the exact voltage heater to use. We also use three small heating irons and one very large iron and with the two sealing wax heaters we find them most convenient. The great trouble is the cost of maintenance—they will burn out, and when repaired very often have to be sent back several times. I have had two irons which held for four years and again two which after being repaired, did not hold more than four weeks. I would be obliged, Mr. Lambe, if you would tell us about the German type of heater.

Mr. Lambe: I am sorry to say I do not know much about the granular carbon heater, although I know it is being worked on. Most of the German types I have heard of were of the coiled wire form of construction, they seem to have gone into that design pretty extensively. About the question of the wax heater, using wax in a water vessel, the point there I think would be that the wax, being thicker than water, did not have the currents set up in it that water would, and therefore did not radiate the heat nearly as rapidly. Therefore the actual temperature, which is controlled just as much by the amount of radiation as by the heat that is put into a device, rose to a higher point than it would with water in the vessel. That, I think, is the probable explanation.

Mr. B. F. Reesor: I have found Mr. Lambe's address very interesting. I would like to ask him if it is possible to use a thermostat in a smoothing iron, as in a heating pad. Our experience with smoothing irons has been frequent neglect in switching off, when the operator was through with the iron, consequently leaving it to burn out the iron. Do you think it would be possible to use a thermostat?

Mr. Lambe: That is a point that is being now worked on, a man I know is experimenting on it. The trouble is that the temperature in an iron is so high as to make the designing of a thermostat very difficult. In heating pads the proposition is comparatively simple, because your temperature is lower, about 170 degrees Fahrenheit, as opposed to, say, five or six hundred in the flat iron. It is understood, of course, that if you leave your iron on the circuit and stand it on combustible material you will have a fire, but then every iron is equipped with a stand, and when idle the iron should be put on it. Then you can get automatic handle switches, which open the circuit as soon as you put the iron down. The trouble, however, with these is that they are rather expensive. There is an iron in which a switch, placed on the heel, opens the circuit when you sit the iron down with the nose pointing up into the air. The trouble, though, is that it is not automatic. You are as liable to forget to turn it up as to forget to put it on the stand.

Mr. A. L. Mudge: This is an imporant question, and some such feature would be desirable in water heaters as well. Has nothing been done with thermostats in that regard?

Mr. Lambe: A fusible plug is sometimes used, very like that in a steam boiler.

Mr. Mudge: With regard to the question of meters, the two rate meter it seems to me would be a better scheme than a separate meter for the heating and cooking apparatus, as it would appeal to the station man as well as being far superior all round.

Mr. W. N. Ryerson: I would like to add my word of commendation for Mr. Lambe's splendid talk on electric heating. It is particularly apropos in view of the President's remarks regarding new illuminants. We look forward to seeing our revenue cut down to a certain extent by the use of lamps of higher efficiency, and here is one way to make that up by extending the use of these heating and cooking devices. The question as to the best methods of introducing these is one to be settled by the individual companies. But the method of introducing them by putting them out on free trial, so far as I have been able to learn, has been most successful. Not only do you get the income from the current used during that trial, but in nine out of ten cases you end by making some permanent users of quite a large amount of current, which as Mr. Lambe said, is taken at other than the "peak" time, which is just what we are all wanting.

Mr. A. A. Wright, M.P.: Suppose I try to sell you an iron. Let me tell my story, perhaps we can do better that way than any other. I say: "Mrs. Brown, I have something here I want to give you to assist you in your work. You know how hard it is to get domestic labor—I need not tell you that. I have something here that is going to help you. It is an electric iron that weighs six pounds. It is just the very thing you want and it will not cost you much. It will cost you just five cents an hour to use it and you can reduce that a good deal if you are careful. I went the day before yesterday to Mrs. Dick to sell her an iron and she said that was just the very thing she wanted. She said: 'Yesterday I went to iron, and it was summer time, so I put on a fire and got the irons hot; just then my child awakened and I had to leave it to take care of her (laughter), and by the time she was quiet the fire had gone down. So I made it up again and got things going nicely when a neighbor came in from the country, and by the time I had got through with her the fire had again gone down. If you will give me something that will heat up just when I want it that is the thing I want.'" I said: "I will send my man around. When do you do your ironing, Thursday? Well, I will send my man then with the six-pound iron. He will read the meter and show it to you and you can use the iron as long as you like. Keep track of the time you use it and you will see that it takes just three minutes to heat for use, and be careful when it is getting too hot to turn off the current for a moment or two to cool it off and see how low you can keep the amount of current you use." When you have told them a story like that and shown them the iron and proved to them exactly how little it costs, then give them the experience and show them how convenient it is in summer time for quick ironing and saving the making of fires when you want to iron out a ribbon or some other small thing in a hurry—that will show them how convenient it is. We never failed yet to sell an iron under such circumstances, where one was really wanted, and I am quite sure that such talk is bound to sell them. (Applause.)

Mr. K. B. Thornton: Mr. President, I have listened to Mr.

Lambe's paper with great interest and it seems to me that it is the commercial end of the matter that we are most interested in. In the United States it has been stated that great efforts are being made by all electrical companies to develop the use of electrical irons and other electrical apparatus, although the cooking business is growing also, especially in the smaller towns.

Reference has been made to the advisability of two-rate meters. In some companies I am interested in we have found it advisable to change the method of billing and bill on the two-rate method and, say, base your rate at 10 cents per kilowatt hour for the first two hours in each 24 on the maximum demand and immediately thereafter drop to five, four or three cents per kilowatt hour—taking account of your demand in the shape of the number of lamps installed and no account of cooking apparatus, fans, etc. With this arrangement a customer gets his current for cooking at four or five cents.

It has been found that the only satisfactory way to introduce small apparatus is by peddling the same from door to door, sending out a man with the irons or other small apparatus, and leaving the appliances on the customer's premises for a thirty days' trial. It is universal experience that only a small percentage of the irons taken out in this way are returned. In fact, the companies find that their main difficulty is to get enough irons to put out. Most of the companies in addition to sending out the peddlers issue dodgers, while some of them issue bulletins from time to time. But the most satisfactory way is to take the iron itself to the customer's premises and leave it on trial. It is also a good thing to have a demonstration in the offices and show windows, like those given by gas companies with cooking ranges, etc.

It seems to me that apart from the small apparatus, the introduction of electric heating and cooking utensils has to be taken up in a conservative, careful way, because it is a well-known axiom that every man kicks on principle at his electric light bill, and unless proper attention is given to the matter of rate you are liable to increase the number of your disgruntled customers.

The President: We are fortunate in having with us to-day a member of the British Institute of Electrical Engineers. I would like to call upon Mr. Welbourn for a few remarks.

Mr. Welbourn: Mr. President and gentlemen, before I say anything, I want to thank you for the honor you have done me in making me a member of your Association. I have been very much interested in this paper, because your methods here are very different from those we have in use in the Old Country.

While a good deal of business is being done in England in using electrical kettles and irons, though but a very small amount of cooking, the great development there has been in the use of electric heaters for private houses. The form used is the carbon lamp almost entirely; here you call it the luminous radiator. Some of the Prometheus type are used, but they are objected to because of the lack of light. It is found that in drawing rooms, bedrooms and dining rooms the light in addition to the heat is very attractive and makes a great advertisement for the device, so that it does not need much pushing to make it sell. Therefore I would suggest to all commercial men that in order to increase their business they should take up the illuminated type, because it is so very attractive.

Another point is that the company with which I am connected has operated two or three stations in England, and we were the first people to go to the straight penny per kilowatt hour rate, and we find that it has been very successful indeed. There are no restrictions whatever. The customer may take his current night or day, on a separate meter entirely. We do not believe in the maximum and minimum system for the small user who takes six or ten lights. These heaters take about one kilowatt per hour, so it would cost a man about two cents an hour to burn the heater. The effect of completely going to that policy has been that one of the largest London companies I know of, the Brompton Kensington Company, had so much business they were really embarrassed with it and their works are to-day very much overloaded all the time. So it shows conclusively I think that there is a very paying business to be done by completely going for this illuminated tpye of heater. (Applause.)

Mr. H. S. Brown: What would your lighting rate be?

Mr. Welbourn: The lighting rate with us varies very much indeed. We have every system under the sun, but taking the average lighting rate for London and district it is about ten cents per hour, but in the country towns it is as low as six cents. Where my own house is in the country we have a rate of eight cents per hour without any restriction whatever.

Mr. Brown: What is the source of power?

Mr. Welbourn: Steam entirely. In England we have only three water power plants of any size, and they are used almost entirely for manufacturing purposes.

Mr. J. J. Wright: You have therefore been overloading your systems with non-paying business. It has taken us all our time to look after the lighting business at eight to ten cents. It would not be good policy to overload these mains and interfere with the lighting distribution and overload the service in order to get a two cent rate, which could not be a profitable proposition.

Mr. Welbourn: I do not agree with that. The man with the radiator in his house is the long-hour burner whom the power companies want on their mains. The long consumer gets a very low rate for day use. Nearly all the London companies have laid ample room for new cables, and could easily put in more. The common voltage in London is 200 to 240, but there is a great deal of reconstruction going on, and in view of the developments in high efficiency lamps some of the newest and largest systems are putting in 105 volts.

Mr. Humphries: I have been connected with companies in England. The way we got out of the low rate for heating was fixing a time limit by means of time switches, so that during the hours of darkness no one could get the low rate current, which quite overcomes the difficulty of overlapping of the two rates.

The President: That is practically equivalent to the two-rate meter.

Mr. Humphries: Yes, practically it is the two-rate meter.

Mr. Thornton: The only objection to that is that time limit switches are an invention of the devil. (Laughter.)

Mr. Hunt: What fuel do you use?

Mr. Welbourn: We use slack and get it at four and sixpence per ton, about $1.08.

Mr. Hunt: I wish we could get it at that.

Mr. Kelsch: Mr. President, I have been very much interested in what Mr. Lambe has said in regard to the manufacture and selling of appliances. We have heard about what to do to induce the customer to buy these appliances. I do not see any customers here, so I will tell my experience as a customer. Some time ago I bought a flat iron, and the first day it worked very nicely. The next day it was not working at all. I enquired into the reason and found that on the second day they started the iron on sheets and other large goods which absorbed the heat so fast the iron would not work, so I bought a larger iron. The next trouble was the breaking of the cord. In buying both irons I received them in boxes, carefully wrapped up, with the cord twisted round it. There was no explanation given of how to hang the cord, and no explanation of how to use the small iron for light goods and a heavier iron for heavy goods. There are seven or eight large supply houses in Montreal, and you can go into any one of them and see electric flat irons of every description. But there are not many electric irons used in Montreal, because the people do not know how to use them, and I think the reason why the companies here have not got a large connected load of heating appliances, especially flat irons, is simply that they have not shown the people how to use them.

At the electric show at the Drill Hall one company has erected a fine kitchen, and has demonstrators showing cooking utensils, heating irons, etc. This exhibit draws a large and interested audience all the time. I understand that three or four hundred pieces of heating appliances and flat irons have been sold there inside of ten days, which clearly shows to me that it is absolutely necessary to demonstrate how these goods are to be used in order to get the customer to buy and continue to use them. If I had not been in the business myself I should have certainly discarded my first flat iron, and perhaps never used another one.

Mr. K. B. Thornton: That is very true. When I spoke of peddling the irons that is what I meant. It is customary for the man taking the irons around to install them and thoroughly instruct the people how to use them to the best advantage.

The President: As time is getting on I will call this discussion to a close, although I am sure much benefit would come from further discussion. But we have a definite program and

a number of papers for this afternoon, and we are to meet here at two o'clock. It is now half-past twelve, and before we adjourn I have a few words to say. First with regard to the program this afternoon. The first paper is entitled "Trials of the Operating Man," by Mr. M. A. Sammett. Mr. Sammett, as you know, has had considerable experience in Europe and is now connected with a large operating company, probably the largest company in Canada, where he has been in many departments and has had a very varied and good experience. Most of you will remember him as the man who read a very interesting paper the last time we had a convention in Montreal, on the effect of frequency on transformers. I am sure his paper will be of great interest to you all.

The second paper is entitled "Three Wire Generators," by Mr. B. T. McCormick. Mr. McCormick, as most of you know, is chief electrical engineer of the Allis-Chalmers-Bullock Company, and a very able man.

The Secretary: With regard to the Question Box, Mr. President. The Question Box Editor, Mr. Dion, will probably not be here until this evening, and perhaps it would be better to leave it over until to-morrow.

The President: Yes. There are Question Box booklets here, and anyone wishing one can get it from the platform.

Another point I wish to mention. Mr. R. M. Wilson, general superintendent of the Montreal, Light, Heat & Power Company, has given instructions to his operating men to allow any members wearing badges to visit any sub-station or power house in the city. Any person wishing to see these will be admitted. I am sure this will be of great interest to you all. (Applause.)

A hearty vote of thanks to Mr. Lambe for his paper was moved by Messrs. Reesor and Williams, and unanimously carried with applause.

After the Secretary had made some announcements the meeting adjourned until the afternoon.

FIRST DAY—AFTERNOON SESSION.

At two o'clock the President took the chair and opened the meeting as follows: "Gentlemen, if you will come to attention we will open our second session. The first item on the program is a paper on 'The Trials of the Operating Man,' by Mr. M. A. Sammett, who I will now call upon." (See page 316.)

DISCUSSION.

The President: Mr. Sammett has given us a very interesting paper. We expected a good paper from him and I am sure we have not been disappointed. When you think of all the different troubles of the operating man in various ways it is a good thing to thresh them out along the lines of the paper. There is one point that struck me as particularly interesting, and that is where the transformer registered a temperature of two hundred degrees Centrigrade. I would like to ask Mr. Sammett how long it was operating at that temperature.

Mr. Sammett: There is no record to show how long the transformer operated at that high temperature. It is safe to say that this condition lasted for fully three or four weeks. After the transformer was removed from the customer's premises it was brought in to the test, and set up in the yard for safety. A series of tests were made. At first a no load test was made which lasted for 50 hours, when the temperature came up to 100 degrees C. After that the full load was started, when the temperature came up to 200 degrees C. in about 24 hours.

The President: How long would the oil remain at that temperature without taking fire?

Mr. Sammett: As long as the transformer oil did not reach a temperature of 235 degrees C. there was no danger of the oil taking fire. Two hundred degrees C. was within the safety limit for the flashing point. There was, however, danger of the gases taking fire in the event of a match being struck close by the transformer.

Mr. W. N. Ryerson: As an operating man I can appreciate Mr. Sammett's paper particularly. I would like to call attention to the statement on page three where he asks whether it is safe to increase the voltage by ten or fifteen per cent. to compensate for increased drop in the line. I should say that is coming close to the point where greater investment in copper would be advisable rather than running the risk of increasing the voltage of the generators to that extent.

Then on page five he says that the proper adjustment of the field current would cause the generators to divide the load proportionately. I presume he means the relative speed of the generators. With the alternators running in parallel the variations in the field current will cause idle or wattless currents to circulate between them without affecting the actual load of the two machines.

I agree with what Mr. Sammett says about the fire risk to oil-insulated transformers. There has been a great deal of controversy over this point and it has been pretty hot at times. But I think to-day everyone concedes that the oil-insulated transformer is a very good risk, and the fact that the underwriters look at it in that way confirms this view.

In regard to transformer oil breaking up and forming a deposit on the cooling coils and in the ventilating spaces, it has been our experience that a very thin mineral oil, a little heavier than kerosene, known as "300 deg. Mineral Seal Oil," has given practically no trouble from depositing at ordinary temperatures.

Mr. Sammett: It is generally understood that Mineral Seal Oil does not break up. But in the case I mentioned of the 200 degrees where the oil broke up it happened to be Mineral Seal Oil, and it was the first occasion I know of where this oil gave that trouble.

With regard to constructing a line to take care of the increased load, it seems to me that the emergency condition lasts only for a short time, for half an hour, or at most for a day or two, and it would hardly be necessary to go to the expense of putting in a line that would operate under emergency conditions with a drop of about 15 or 20 per cent. When the emergency gives a larger drop it would be safer for a short time in the generators than running ten or fifteen per cent. high. That I think would be a better solution, especially with the price of copper so high as it is at the present time.

Mr. A. A. Wright: What is the signification of Mineral Seal Ooil?

Mr. Sammett: It is simply a trade name. The oil is very light, and allows of free circulation.

Mr. A. B. Lambe: Can Mr. Sammett give his ideas about grounding, particularly with the 110 two wire system. Is it satisfactory without taking the trouble to bring out a neutral?

Mr. Sammett: If there is no neutral provided on the transformer, it is advisable to ground one end of the low tension winding. When a transformer is removed from the case, the handling of the coils, which were in service, frequently results in causing damage to the transformer. Actual experience shows that the life of transformers is considerably shortened by such handling. I am in favor of grounding one end of the 110 volt side.

The President: In reference to that point I had a discussion with Mr. Skinner, of the Westinghouse Company, some years ago. He said that he was opposed to so many taps on the transformers and wanted to minimize them and not bring out the neutral taps. He had taken it up with the underwriters and discussed it with them, but they would not allow the grounding of one side, although the electric men could not see any good reason why they should not do so, but the insurance people were arbitrary on the point and would not put it in their rules. Personally if it were in my house I would have one side grounded if no neutral point were available.

Mr. Lambe: Is that ruling still held by the underwriters?

The President: It was until some years ago. They are not objecting now that I know of—but objection or no objection, I would ground one side if no neutral point were available.

There are many interesting points touched upon in Mr. Sammett's lecture, but as time is getting on I would ask you to discuss the paper quickly in order to get them all out. One point strikes me, and that is the testing of the transformer banks together. I had a case of this kind recently where a very heavy load was connected up in one building and it was necessary to bank four or five transformers of 25 kilowatt capacity together. The load was, say a little beyond where the blackboard is, one pole where the lantern stands, another pole in this corner and another in that. The foreman of construction put two transformers on the lantern pole and two on this, and connected them all in parallel, expecting them to divide the load equally. We were fortunate enough to have current transformers with a split core, and the load was taken on the transformer nearest the load, less than fifty or sixty feet away. The

(Continued on page 332)

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The Electrical Exhibition and Convention It can now be stated without fear of contradiction that no mistake was made by the Managing Committee of the Canadian Electrical Association in postponing the annual convention from June to September, in order that it might be held simultaneously with the Electrical Exhibition in Montreal. The Exhibition was admitted by everybody, including many visitors from the United States, to be the equal of anything of the kind ever held on the American continent. Perhaps not as gigantic as some of the American shows, but quite as complete in the display of electrical inventions and novelties. To the management much credit is due for the success of the undertaking, which reflected carefully-planned arrangements throughout. The Electrical Association convention was probably the most successful that has yet been held. Ample entertainment was provided, but it was so arranged that it did not interfere with the business sessions. The dispatch with which the President carried out the program, utilizing every moment to advantage, is a policy worthy of emulation. The Association is also indebted to the presiding officer for his active participation in the discussions, which in other hands might easily have become less interesting.

One very important step was taken at this convention, in the adoption of a constitution which more clearly defines the policy of the Association. The formation of an Executive Section, composed of representatives of private lighting and power companies, should lead to a larger membership from these interests, a result much to be desired. The Association has also recognized the necessity of more active committee work. One committee will interview the Dominion Government with a view to securing a reduction in the fees charged for the inspection of electric meters; another will report on the many new types of high efficiency lamps and their probable effect on the income of central stations.

Of the ten papers presented at the convention none were lacking in interest. The contributions relating to the modern illuminants, in the form of the Nernst, Tungsten, Tantalum, and other lamps, were especially instructive and helpful to central station managers, who recognize that in future they must give earnest consideration to the question of securing a more uniform load on their plant. The policy of many central stations in the past has been one of apparent indifference, with little attempt to find new customers and develop new business. What can be accomplished by a progressive policy of business-getting, backed up by reasonable rates and satisfactory service, is illustrated by the experience of the New Bremen Electric Light Company, of New Bremen, Ohio. In a village of fifteen hundred population this company sell electric current to the value of $11,500 per year, or at the rate of about $8.50 per year for each man, woman and child. The company have competition from natural gas at 25 cents per thousand, but nevertheless are steadily increasing their load. Their motive power is gas engines and their current costs to deliver about 3 1-4 cents per kilowatt, while on a graded scale they receive an average of seven cents per kilowatt. Their load includes four dairy farms, two slaughter houses, a large creamery, coffee grinders, churns, cream separators, washing machines, sewing machines, heating utensils, etc. With flat irons they have had excellent results, having fifty now in service. Here is an object lesson for central stations whose revenue is low in proportion to the investment. Give more attention to the solicitation of new business, without neglecting your present customers, and the result will surprise you. Commercial questions will doubtless be more prominent in future conventions of the Canadian Electrical Association.

THREE WIRE D. C. GENERATORS*

By B. T. McCormick.

It is the purpose of this paper to give briefly the principles of operation of three wire generators and to call attention to some of their advantages. The three wire generator is the outgrowth of the well known Edison three wire system, in which two direct current generators are connected in series, with a line known as the "neutral" tapped into the point where the machines are connected together. A load, usually light, is fed between each outside wire and the neutral. If the load is balanced on either side, no current will flow in the neutral, while in the event of an unbalanced system the neutral will be required to carry the current corresponding to the amount of "unbalancing." The main lines must be of sufficient capacity to carry current corresponding to the combined output of the machines at a voltage equal to twice the voltage of one machine, while the neutral need be only large enough to take care of the unbalancing. Such an installation when applied to a well-balanced 120 volt incandescent lighting load, combines a saving in copper as a result of transmitting at the higher pressure of 240 volts, together with the advantage of a 120 volt installation for supplying the lights. It also possesses the advantages of a 240 volt system for power purposes, the motors being connected across the outside lines.

The three wire generator is designed to accomplish the same results as the Edison three wire system. It is more efficient and not nearly so cumbersome, as only one generator is required instead of two generators of half the capacity.

The three wire generator consists of a direct current generator of the standard type, but provided with slip rings to which are attached taps from the armature winding as in a rotary converter. A transformer known as the "balancing transformer" is mounted behind the switchboard or in some convenient position, and connected across the slip rings. A tap is brought out of the centre of the transformer winding, to which the neutral wire is connected. Fig. 1 shows diagrammatically a three wire generator in its simplest form, the two pole diagram being used for simplicity. "A" and "B" are the main leads and "N" is the neutral. So long as the loads on each side of the neutral are equal, the balancing transformer, "T," takes only the magnetizing current for which it is designed, but where one side is loaded more heavily than the other, the excess of current flows through the neutral into the middle tap of the transformer, and divides, as shown by the arrows "P" "P," half flowing to one ring and half to the other. In so dividing, the ampere turns in one half of the transformer, due to the direct current, exactly balance the ampere turns in the other half, thus the magnetic flux in the balancing transformer remains constant regardless of the amount of direct current flowing. From the above, it is evident that the requirement for a balancing transformer is, that it shall have sufficient current carrying capacity to carry the unbalanced current and a sufficient number of turns and core area to generate a counter electro-motive force, the effect value of which is $\frac{E}{\sqrt{2}}$ where "E" is the normal direct current voltage between brushes.

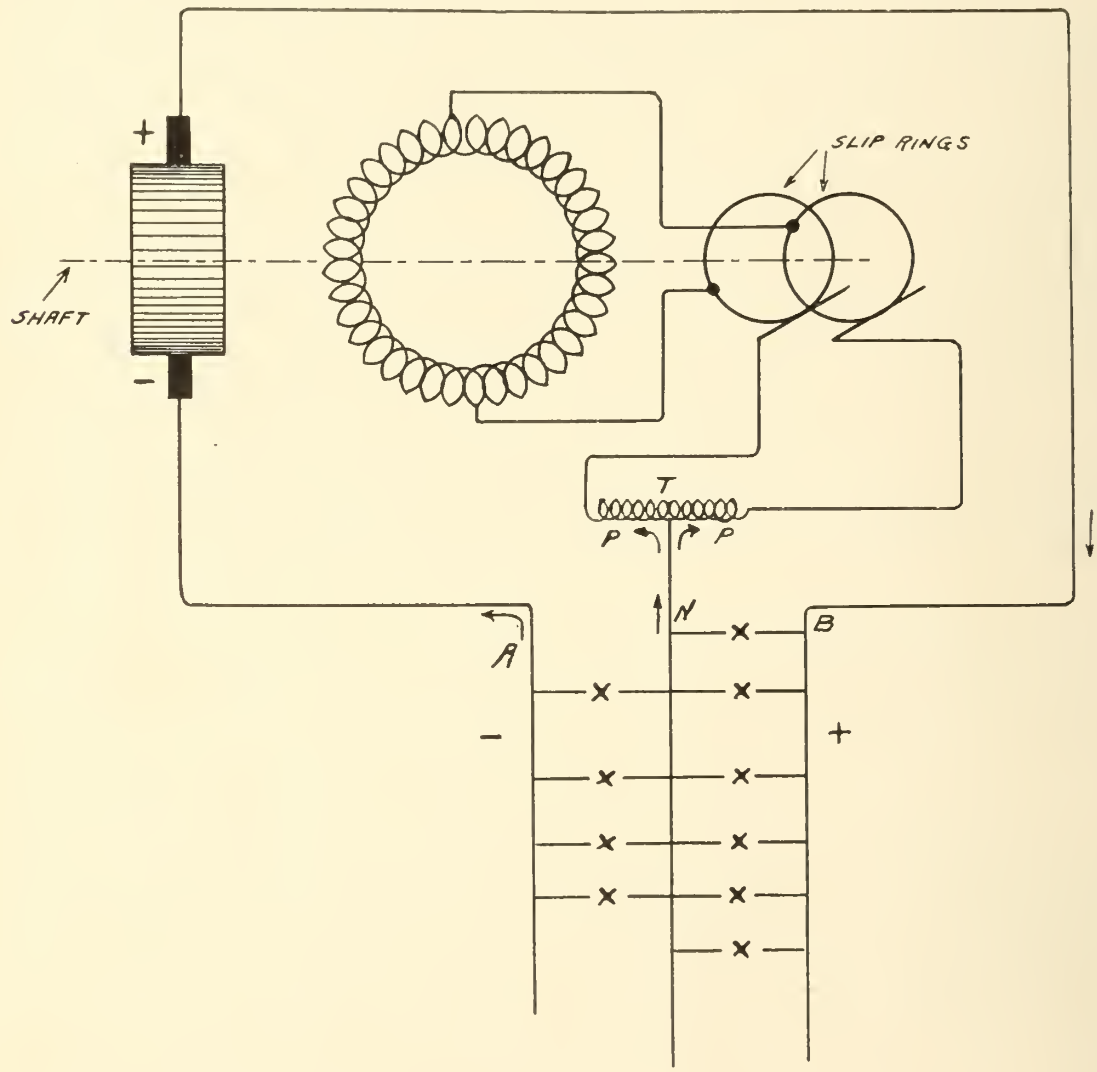


Fig. 1

A core type of transformer is admirably suited to such service, and the coils on either side of the neutral tap are comprised of sections staggered from one leg of the core to the other, in order to reduce the magnetic leakage to a minimum.

Probably the most efficient three wire outfits consist of a generator as described above but provided with a two phase combination of balancing transformers, as shown in Figure 2. The centre taps are tied together and the neutral wire joined

* Paper read at the Annual Convention of the Canadian Electrical Association, Montreal, September 11, 1907.

to the point of connection. Two pairs of slip rings are used, connected to taps in the armature winding situated 90 electrical degrees apart. Such a combination of two transformers results in a more even current distribution in the armature than can be secured by the use of a single transformer.

The cost of the balancing transformer is a very small part of the total cost of the apparatus, and depends of course upon the amount of unbalancing to be allowed. Ordinarily an allowance for about 25 per cent. unbalancing is sufficient. A concrete case will serve best to illustrate the size of transformer required. Suppose we wish to design a two phase combination of balancing transformers for a 100 kw. 250 volt machine to take care of 25 per cent. unbalancing. The amount of current taken by two transformers is that corresponding to 25 kw. or 100 amp. and for one transformer 50 amp. As the current divides on entering the centre tap of the transformer, the copper sections need be made only large enough to carry 25 amp.

The two wire generator, with rotating d. c. balancers, as a competitor of the three wire generator, possesses a great many good points, but the cheapness, simplicity and compactness of the three wire generator are points not to be overlooked in deciding on a three wire system.

MUNICIPAL MISMANAGEMENT.

Toronto, Sept. 5th, 1907.

Editor Canadian Electrical News:

Dear Sir,—While the subject of municipal ownership is so much in evidence at the present time, it might be interesting to the electrical fraternity to hear something of the methods adopted by some municipalities.

In a recent edition of The Electrical News a very nice article was published illustrating and describing the electric plant in the town of East Toronto, but little did the readers of the article know of the howling farce which is being enacted in the municipal government of this plant. It is needless to say that if it were operated by a private company it would be

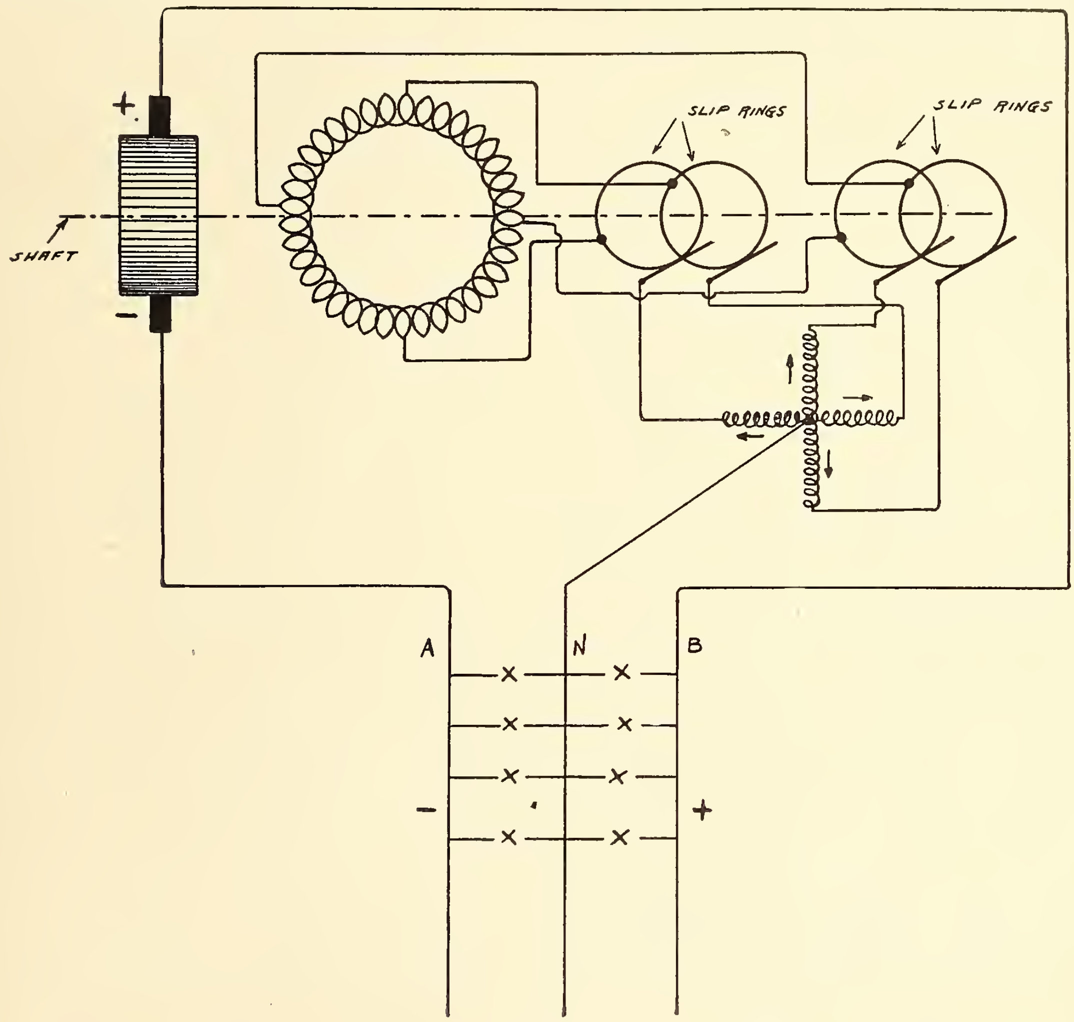


Fig. 2.

The number of turns and core area must be such as to give a counter e.m.f. of $\frac{250}{\sqrt{2}}$. The volt ampere capacity must therefore be $\frac{250}{\sqrt{2}} \times 25$. As a balancing transformer has but one winding, whereas an ordinary transformer has both a primary and a secondary, the above value must be divided by two to get a basis of comparison with a standard transformer $\frac{250}{\sqrt{2}}$ $25 \times \frac{1}{2} = 2.2$ kw. Roughly speaking, therefore, the transformer should be about the size of a 2.2 kw. lighting transformer.

The generator, if shunt wound, differs from standard generators only by the addition of the slip rings, while if compound wound, the alternate poles are connected so that half the poles receive their series excitation from each of the main leads. In this way the corresponding characteristics are still maintained even if one side of the system is completely unloaded.

Three wire generators can be operated in multiple with one another, or in multiple with two wire generators, and it is often convenient to operate a 120 volt machine in multiple across one side of 240 volt three wire system, to maintain a better balance, in case that side is unloaded.

a fit target at which to shoot the arrows of public criticism. If the municipal ownership of other electric plants throughout the country is going to be controlled or mismanaged as it is in East Toronto village, I hope for the sake of my fellow-ratepayers that the private companies will be allowed to retain possession, even if customers have to pay a few cents per year more.

The ratepayers of East Toronto were asked to vote a large sum of money for the new electric plant, buncoed into believing that they would get an improved service. Imagine for one moment an electric service which has the power on mostly during the day time for pumping water, and at 6 p.m. every night just as the people are sitting down to their evening meal, the plant is shut down. It is again started up somewhere between 7 and 8 p.m., and is then shut down at 12.30 p.m. It is never on again from that again until 9 a.m. or after, so that in the dark winter mornings candles, lamps or gas have to be used, and during the night anything that can be found in the form of illumination has to answer the purpose. Letters, complaints or petitions are of no avail, and the Town Council of this place absolutely disregard the many complaints and appeals for a proper service. Enquire of any of the citizens of East Toronto or Balmy Beach district who use electric light and see whether this is not correct.

Hoping you will publish this in your next edition,

Yours very truly,

East Toronto Taxpayer.

Trials of the Operating Man*

By M. A. Sammett.

The difficulties in operating alternating current systems may be sub-divided into two main groups:

(1) Difficulties beyond control.

(2) Controllable difficulties.

Under the difficulties beyond control are to be included those met with every summer. Lightning still engages the attention of the best men of the engineering profession. Various types of arresters were developed, all more or less effective in lessening the disastrous results of lightning, yet none providing perfect protection. Numerous methods to protect the transmission line were introduced with a certain degree of success, but the annual visitor still does its work of destruction.

We shall not enter into the discussion of the existing protective apparatus. The subject has for some years past been most prominent in convention discussions.

The subject matter that will be considered is that of troubles that are controllable; trials that may be overcome by the operating man, provided he were given a plant of a certain amount of flexibility, and that he were provided with information which naturally belongs to him.

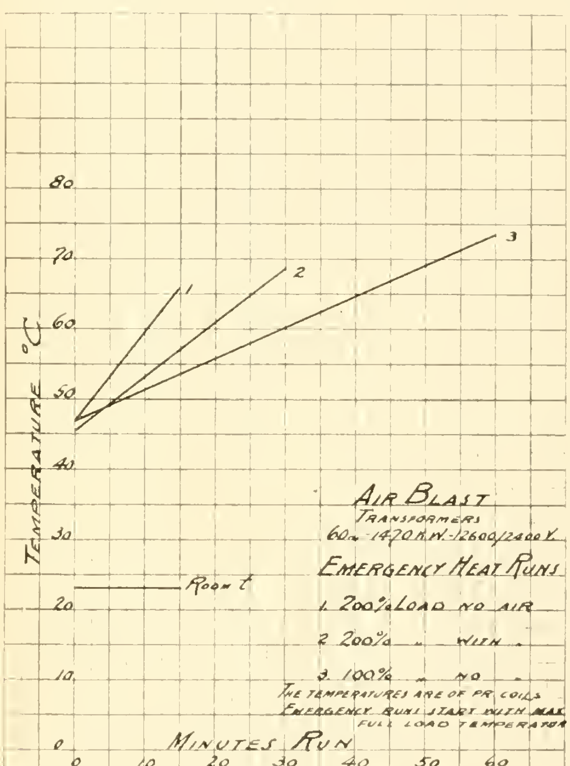


Fig. 1.

Taking up the various items, we will consider first the questions of liberality in the design of the plant. By liberality I do not mean the use of apparatus in capacities much in excess of the requirements. There is no necessity of installing units which will carry continuously 50 per cent. overload at moderate temperatures. This would mean a much larger installation and naturally a more expensive one. What is essential is that the apparatus should be capable, under emergency conditions, to carry 25 per cent. or 50 per cent. overload for a specified interval. Higher temperatures will be allowed under these unusual conditions as long as the temperatures are not detrimental to the life of the machine.

Second in importance, under emergency conditions, will come regulation. What could be suffered under emergency conditions may not be tolerated under normally operating conditions, yet provision should be made for the service to be maintained with a fair degree of voltage regulation.

Bearing these in mind, the design of the power house, sub-stations and the transmission circuits must be such as to provide for the temporary disability of a part of the plant and be in a position, at the same time, to handle the load without any serious interruption.

Under the present conditions of increase of raw material, and consequently of the finished product, the problem of maximum permissible units to be most advantageous under given conditions of operation is becoming prominent in power house

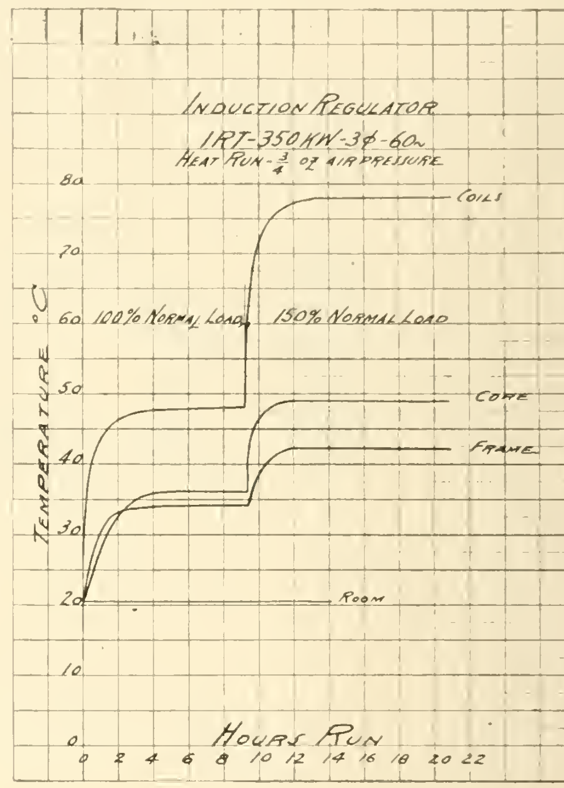


Fig. 3.

economy. This will naturally result in adopting units of larger capacity and will involve almost invariably transforming and regulating apparatus of artificial cooling. All these will tend to complicate matters for the operating man. The auxiliaries used in artificial cooling may at times become in

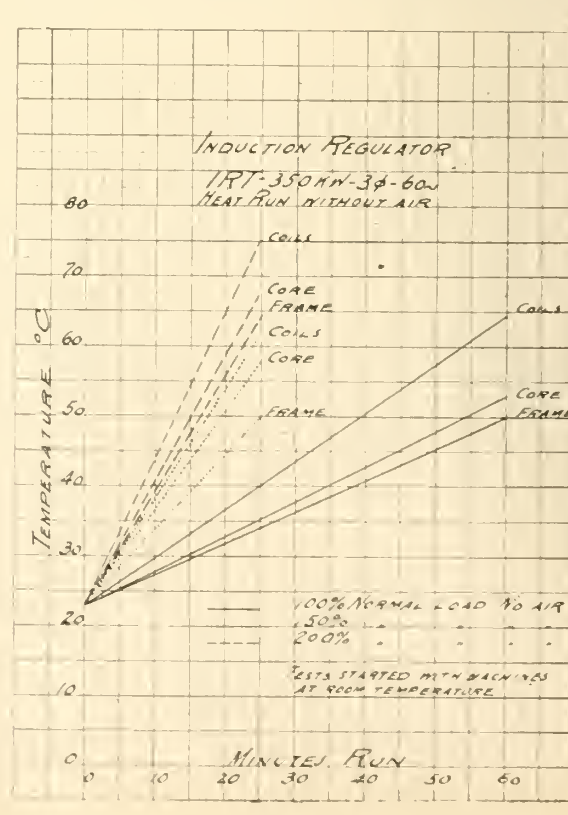


Fig. 2.

* Paper read at the Annual Convention of the Canadian Electrical Association, Montreal, September 11-13, 1907.

operative, and then it is for the operating engineer to be equal to the occasion and display his knowledge of the plant entrusted to him, executing his work with a degree of certainty and a full knowledge of existing conditions.

The operating man should know the behavior of his machines. With this information the operating engineer can handle his plant in an intelligent manner, and in emergency cases will be able to plan his work, being fully aware of the

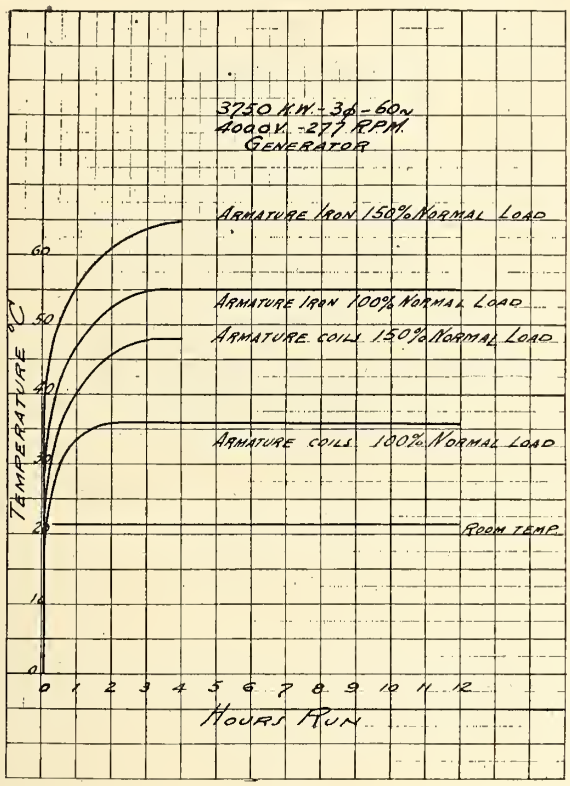


FIG. 4.

time at his disposal for safe operation of the machines under overload conditions, or under conditions of no artificial cooling.

It is evident that machines rated at a given capacity when operated under overload conditions will have a higher temperature. It takes a certain length of time before the dangerous temperature is reached, and it is essential that the curve of temperatures at overloads be known and should be used as a gauge when emergency cases arise.

In modern plants of liberal design where provision of continuity of service is given due consideration, at least two lines should be constructed, and the design of these circuits should be such as to enable the carrying of the entire load on one circuit. The operating man, in such a case, will be confronted with the difficulty of low voltages on the receiving end. The increased load transmitted over one circuit would result in an increased drop in transmission. The provision made in the design of the line would only partially help matters, and to improve the receiving voltage it is necessary to increase the voltage of the generator. How far would it be permissible to increase this voltage? Reference to curve 5 will show that the increased voltage means increased iron loss in the armature laminations, consequently higher temperatures. It would also mean a larger field current, tending to increase the temperature of the apparatus still further. A higher impressed voltage on the step-up transformers will mean also a greater iron loss, resulting in higher temperatures.

Is it safe to increase the voltage of the machine by 10 per cent. or 15 per cent. to compensate for increased drop in the line? The answer to this question may be given only after the study of each particular machine. In the case under consideration we find from the core loss curve, Fig. 5, that an increase

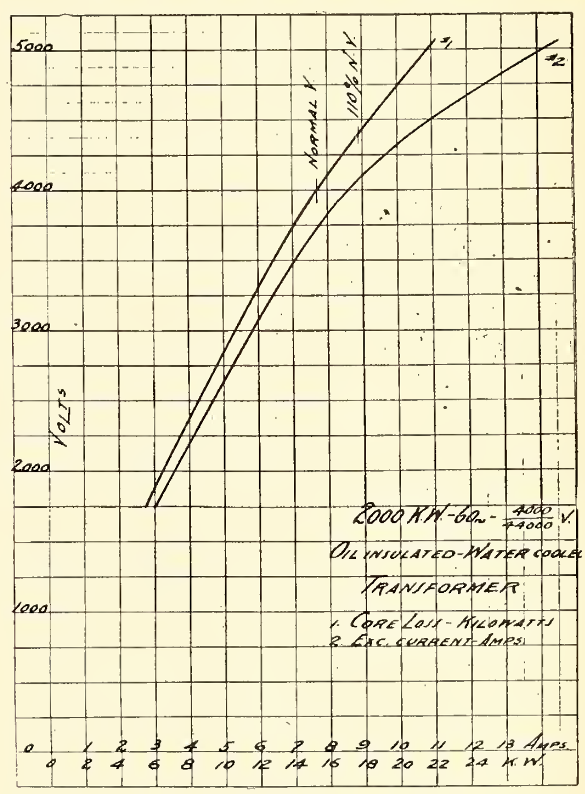


FIG. 6.

of 10 per cent. in voltage of the generator is equivalent to an increased loss of 18 kw. This increased loss is so much heat added to the body of the armature and the corresponding increase of temperature resulting from that will be approximately 5 1-2 degrees C., giving a maximum temperature of 41 1-2 degrees C. No difficulty should be anticipated from the above increase in voltage on the ground of increased potential between turns and layers of winding, or from increased strain to ground. The increase is too small, and the factor of safety is large enough so that no trouble need be expected from that source.

At the present state of progress in the electrical art, no difficulty is expected from running generators in parallel. With the refined methods of synchronizing, whether turbine or engine driven, generators will give no trouble. Engine builders have overcome the old time difficulty encountered with engine driven generators. The maximum fluctuations from absolute uniform rotation is kept within 2 1-2 electrical degrees, and this problem has been solved.

With proper adjustment of field current the generators will divide the load proportionally. In this respect they are more under the control of the operating engineer than some of the less complicated apparatus, such as transformers. Over and under excitation of generators will cause a flow of circulating currents between the generators. The adjustment of the field currents will eliminate these idle currents. In this respect the

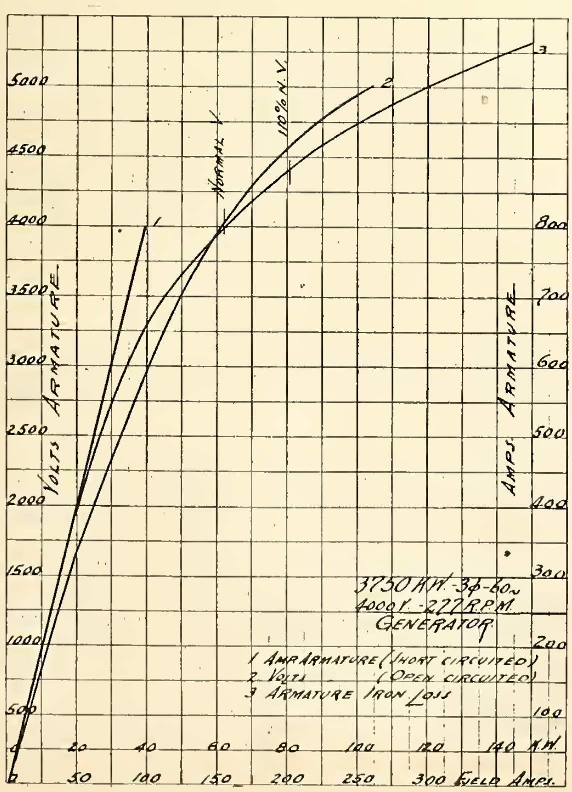


FIG. 5.

use of power factor meters on each machine is of considerable assistance.

In order that transformers may divide the load equally, or in proportion to their capacities, it is necessary that their primary and secondary voltages be the same, also that they have the same impedance.

Many a station man has a tale of woe as a result of indiscriminate use of transformers, and strange to say, sometimes using transformers of same make and type, but built at different times by the same manufacturer, guaranteed for successful parallel operation with transformers previously supplied.

To guard against unequal loading of transformers, the characteristics determining the division of load must be known. It is not necessary to have indicating ammeters showing the current on each transformer, as this would complicate the switchboard. It is advisable, however, to verify at the outset the division of load under actual conditions of operation, and the results, if satisfactory, will remain unaltered.

In more than one instance was it the experience of the writer to find that transformers, though of supposedly same characteristics, would not operate properly, and in one case, when a bank of transformers was connected in service during the

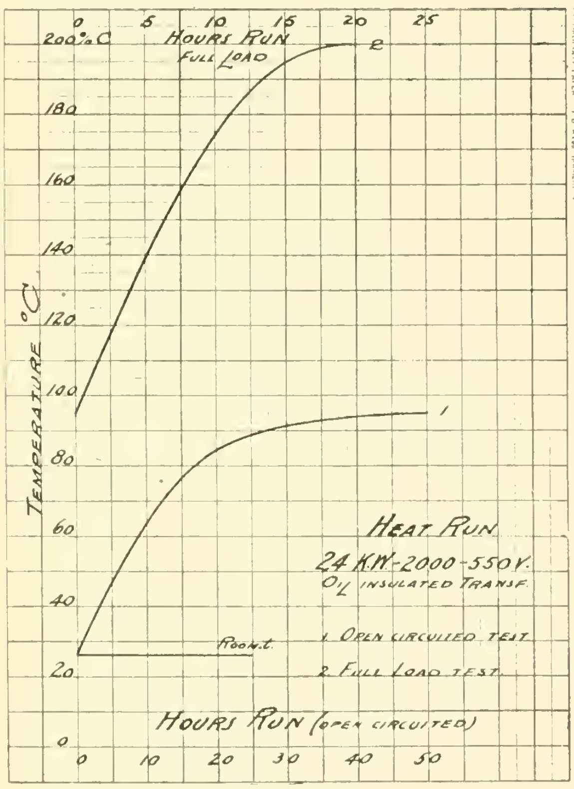


Fig. 7.

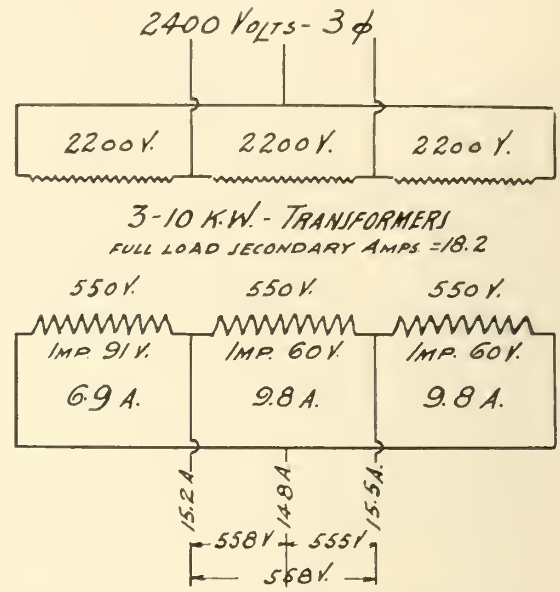
pressure of a heavy Christmas load, the bank burned out in a few days after installation, due to overload. Time could not be spared to test the transformers for impedance. They were connected in parallel on high and low tension windings on the strength of the manufacturer's guarantee. A test made subsequently of two spare transformers supplied on the same order as those that burned out, revealed the fact that the new transformers had an impedance of 3.58 per cent., while the old transformers had 4.4 per cent., and consequently the new bank carried an overload of 19.0 per cent.

With the transformers the question of proper parallel operation must be verified, and if they will not divide the load proportionally to their capacities, corrective reactances must be added to the transformers to equalize them in this particular respect.

Of the various types of transformers the natural draught transformer is obsolete in this country, whether in large or small sizes. The smaller sizes are almost altogether of the oil insulated type, while in the larger sizes they are provided with forced ventilation, such as air blast or oil-insulated water-cooled. Let us consider the two types, air blast and oil-insulated water-cooled transformers, as to the difficulty in connection with their operation.

Air blast transformers are open to criticism on account of the ease with which they accumulate dust. This is objectionable, especially so in transformers of moderate voltages, between 15,000 and 22,000 volts. In this type of transformers it is frequently found that the temperatnre of the npper portion of the coils is much in excess of the average winding temperature.

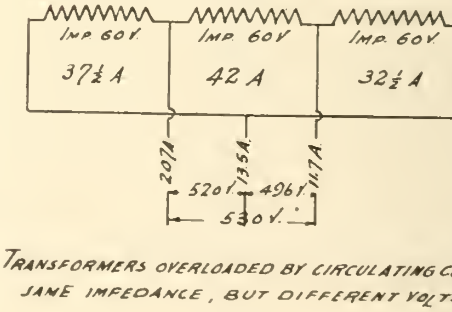
Whenever transformer coils are connected on top, the air passages are frequently blocked, and the temperatures reach a dangerous point, at which it will be unsafe to continue operation. To the above mentioned objections must be added



Unbalancing of load on transformers of same voltage, but different impedance.

Fig. 8.

another, that of the danger of using compressed air for blowing out the dust. Unless the air is perfectly free from moisture, the use of it may result in the damage of the insulation and cause a burn-out. If extreme precaution is not exercised disastrous results will follow. To all these trials must be



Transformers overloaded by circulating current. Same impedance, but different voltage.

Fig. 9.

added another, that of the case with which the flames are carried from one transformer to the other through the air chamber.

With the oil-insulated water-cooled transformer, many of the above enumerated defects will be overcome. With oil-insulated transformers a smaller amount of insulation wrapping the coils is necessary, hence the uniform ducts of larger magnitude are possible. The temperature of the coils with such construction of ample oil circulation will be more uniform.

The principal argument in favor of oil-insulated water-cooled transformers is their ability to withstand excessive overloads, and their immunity from breaking down at temperatures even as high as 200 degrees C. This dangerous temperature

was reached under abnormal conditions of phase transformation. One transformer was operating at about 72 degrees C., while the other ran at a temperature of 200 degrees C. Room temperature 42 degrees C. The difficulty was discovered when an inspection of the transformer installation was made. A thermometer of 150 degrees C. range was lowered into the oil, and when removed to take the reading the mercury was up to the end of the scale, and the mercury bulb had broken. A larger range theremometer registered 200 degrees C. When brought into the testing department the transformer was given an insulation test of 10,000 volts from primary to secondary and ground, also from secondary to ground of 5,000 volts, which it stood successfully.

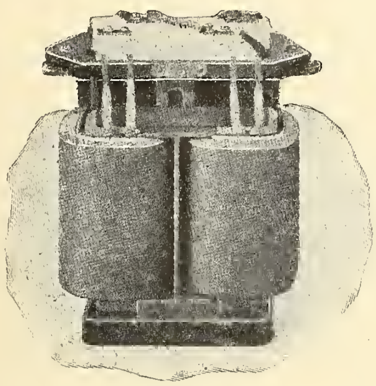


FIG. 10.

Double voltage was applied across transformer terminals, and the insulation stood the test.

The rating of the above mentioned transformer is 24 kw.60 cycle-2,000-500 volts.

A great advantage of the oil-insulated transformer is the higher effectiveness of insulation to resist induced high voltages, either through switching or through lightning disturbances. The fear of oil in the transformer as a fire risk is a matter of the past. Instances of stations destroyed by fire when oil-insulated apparatus such as transformers and regulators were the only machines saved, show the fallacy of the opponents of oil-insulated apparatus. Oil will extinguish the arc resulting from a short circuit in the transformer, and prevent the burning of the insulating fabrics, thus doing away with the smoke filling the station, as is always the case with air blast apparatus. The temperature of the oil-insulated apparatus is more uniform throughout than those of the air blast type.

As to the oil syphoning through the leads and case joints,

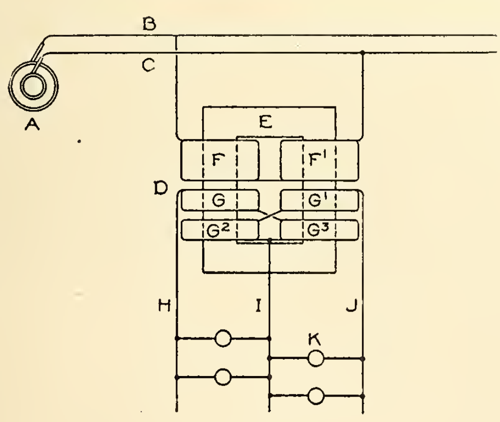


FIG. 11.

there is no reason why, with the proper coustruction and necessary precautions, the oil syphoning and leaks should not be done away with.

While it has many advantages the oil-insulated water-cooled transformer has two main draw-backs:—

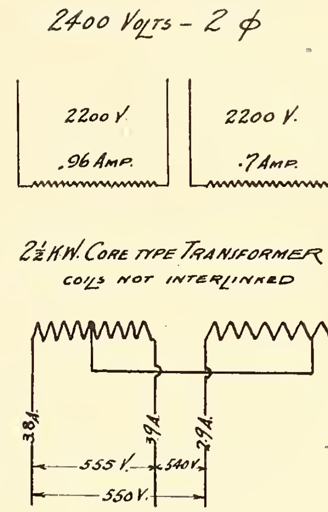
1. Possibility of water getting at the winding.

2. Breaking up of the oil, forming a thick non-conducting mass.

A defective water coil or a coil allowed to have the water when the transformer is not in use during winter months will damage the transformer.

A water coil capable of withstanding 200 pounds hydrostatic pressure and proper connection of the coil to outside piping will guard against the former difficulty, while care exercised to remove the water from the coils by an air pump or by filling it with oil under pressure will guard against trials of water freezing in the pipes.

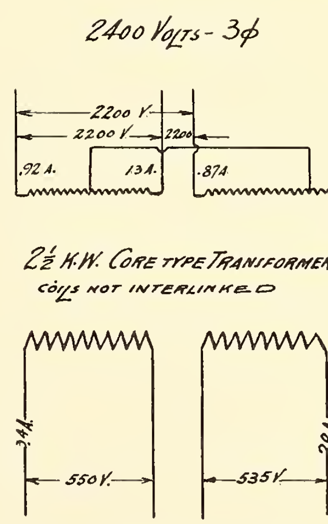
The breaking up of the oil takes place only at high temperatures, and if transformer temperatures are kept low no difficulty should be anticipated. A sample of oil subjected to a temperature of 90 degrees C. formed a heavy deposit in two weeks. Further tests could not be continued due to lack of time, but it is safe to conclude, however, that it is not advisable to allow transformers to reach a temperature in excess of 70 degrees C.



Unbalancing of Load on Core type Transformers.
Load - 7½ H.P. Ind. Motor. Running Light.

FIG. 12.

It happens sometimes that through uo explainable reason the temperatures of transformers begin to rise. The cause may be due to either the irou aging, which would result in a higher iron loss, or to breaking up of the oil, or again to clogging of the water cooling coils. In one instance where water was carried to the brass cooling coils through an iron pipe the asidulated water passing through the iron pipe attacked the iron and then going through the brass tubes deposited the iron in



Unbalancing of Load on Core type Transformers.
Load - 5 H.P. Ind. Motor. Running Light.

FIG. 13.

the form of a sediment which reduced the coil opeuing to one-third its normal side, hence the consequent rise in temperature.

TRANSMISSION LINE.—The connecting link between the generating and distributing ends is the transmission circuit. The trials here are caused by the insulators. Iusulators should receive as much consideration as the power house and sub-station

machinery. They must have a liberal margin of safety. They must possess the requisite mechanical as well as electrical strength. While the dielectric strength is of great importance in selecting a suitable insulator, the surface leakage of the insulator should be such as to have, under conditions of rainstorm, a factor of safety of three times normal voltage for moderate voltage transmission. For voltages of 60,000 volts and above, this requirement will have to be modified and a smaller factor of safety will have to be adopted, since the insulator will otherwise prove too costly on account of size.

In selecting the kind of insulator attention must be paid to local conditions. The peculiarities of the country the line passed must be taken into consideration and proper allowance made for local atmospheric and climatic conditions, for the effect of close-by chemical works, railway lines, with the unavoidable fumes, smoke, etc.

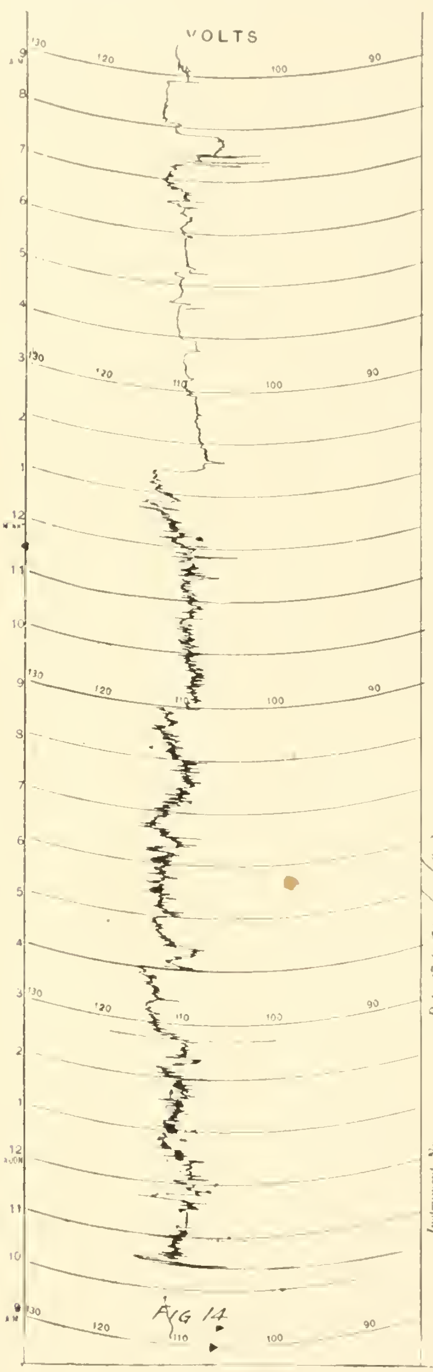


Fig. 14.

Rigid requirements of an insulator possessing a factor of safety of four times for arcing over under a breakdown dry test will justify the expenditure for a more costly inhulator by minimizing breakdowns and insuring reliability and continuity of service.

Distributing Circuits.—The distributing circuits in Canada are almost invariably of 2,200 volts alternating current. The economy of distribution at the above mentioned voltage and the severity of the Canadian winter compel the use of overhead distributing circuits. This system requires the extensive use of step-down transformers for both lighting and power service.

Transformers of 2,200 volts in sizes below 50 kw. of pole suspension type are a very simple apparatus. They are self-contained and require no attention. If installed in sizes of ample capacity to handle the load there is no need of giving it any further thought. The experience of small plants will corroborate these conclusions. But as the plant reaches considerable magnitude and the variety of types of transformers multiply, the difficulties begin to increase.

What are the trials in this connection?

They may be classified as follows:—

1. Unequal division of load on parallel operation.

2. Unequal division of load on three phase delta connections.

3. Phase transformation.

The chief requirement of transformers operating with proper division of load is the equality of impedance volts. In other words, given two transformers, either of same or different capacities but of same inductive drop at a given current, the transformers will divide the load proportionally to their capacities. Actual test figures should be accessible and the record of each transformer should contain this information.

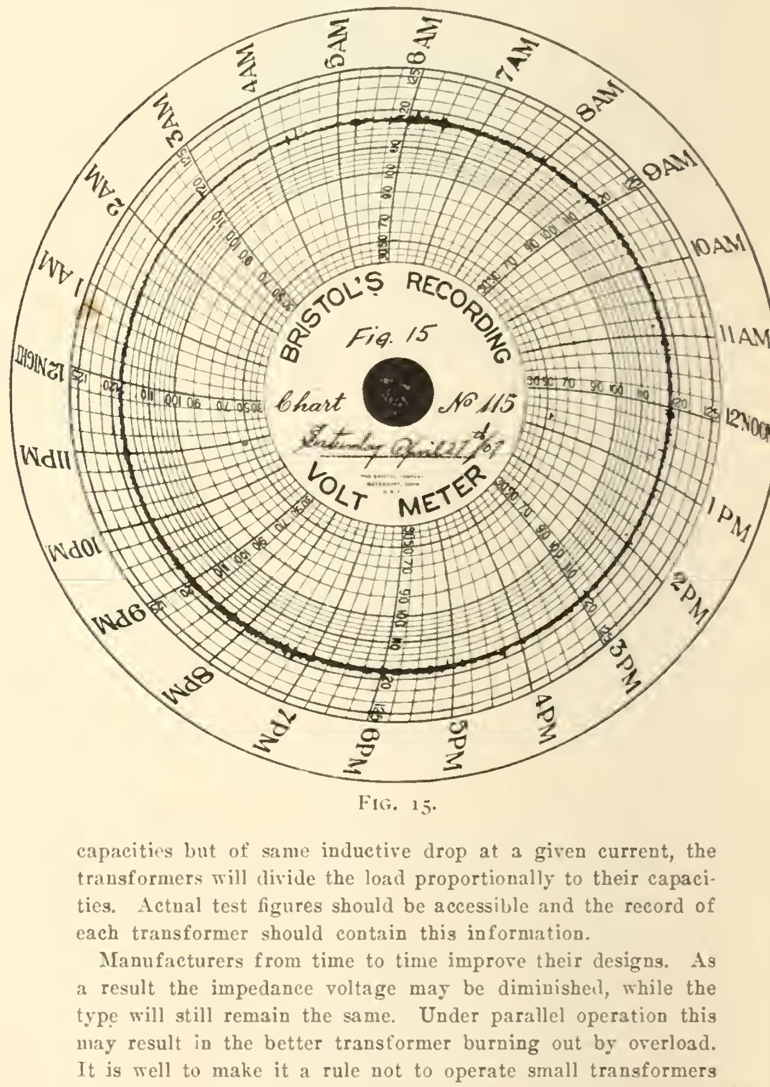


Fig. 15.

Manufacturers from time to time improve their designs. As a result the impedance voltage may be diminished, while the type will still remain the same. Under parallel operation this may result in the better transformer burning out by overload. It is well to make it a rule not to operate small transformers in parallel. The practice will prove beneficial from considerations of efficiency economy, as well as many trials attending parallel operation.

Single phase transformers when connected on polyphase circuits for the supply of polyphase currents must possess the same characteristics with regard to division of load as one phase transformers connected in multiple on single phase circuits. That is, three transformers connected for three phase delta to three phase delta must have their impedances the same, otherwise while the load on the group of transformers is balanced, each transformer will carry a load inversely proportional to its impedance volts, and the better transformer as to impedance will be forced to take a larger portion of the load and may carry a considerable overload. Figures 8 and 9 will give a relative idea as to the inequality of the load on each transformer. In many instances transformers failed under overload conditions, yet records of connected load and actual ampere readings would lead one to believe that the transformer operated under normal conditions. To determine the load of

each transformer, ampere readings must be taken on each transformer proper.

Phase Transformation.—Phase transformation, such as three phase to two phase, or visa versa, are more easily accomplished with shell type transformers than with core type transformers. Inasmuch, however, as for small units the core type transformer has become universal for distribution work, we will analyze this latter type. It is generally understood that in phase transformation the three phase circuit requires the 50 per cent. of one transformer to be connected to the 86 per cent. of the other transformer. While it holds good with shell type transformers, it will not apply to core type transformers

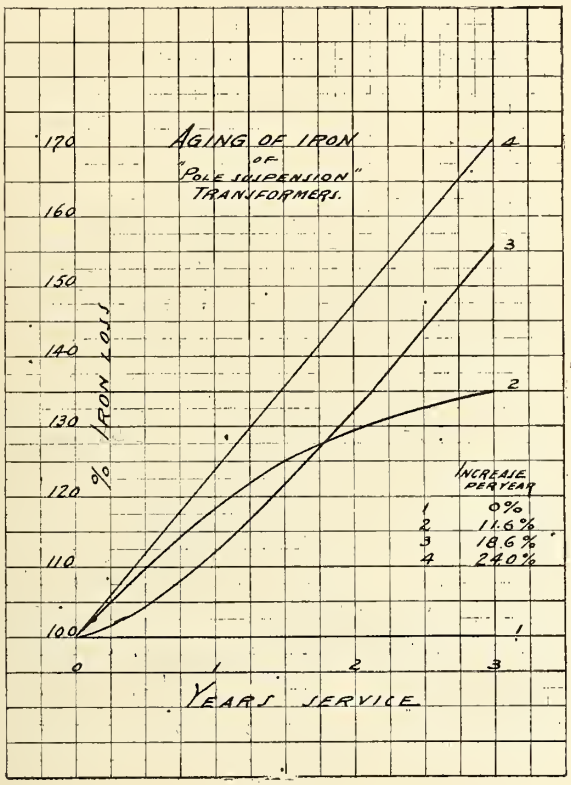


Fig 16.

unless special provision is made for the inter-linkage of coils of both primary and secondary winding. In the early days of the core type transformer development, the advocate of shell type transformers maintained that a core type would not operate on a three wire system. The table below will show some results when interlinkage of coils is not resorted to.

Test of 7 1-2 kw. 60 Cycle Core Type Transformer, 100-200 Volts. Three Wire Secondary Without Interconnected Coils.

	Side A.	Side B.
Load	0	0
Volts	104	104
Load	27 amps.	27 amps.
Volts	102.5	102.5
Load	27	0
Volts	87	125
Load	54	54
Volts	100.5	100.05
Load	54	0
Volts	63	150
Load	0	54
Volts	149	63

This difficulty was soon overcome by sub-dividing the secondary coils in two sections and interconnecting the sections as shown in sketch.

In phase transformation the same difficulty was encountered and the same remedy effected the change desired.

It may be said that in small sizes of 50 kw. and under the shell type has proven a failure and that the core type is the recognized standard for both lighting and motor service.

The construction of the core type transformer at once suggests the ease of insulating the high from the low tension coils. In addition to that, whenever minimum material for a given capacity is not the principal object, the coils can be wound on a perfectly circular form, thus avoiding corners and insuring freedom from short circuiting the winding on account of the bends. While grounding of neutral points of low tension transformer winding is effective in keeping the high tension out of the customer's premises, the possibility of the breakdown should be guarded against by selecting transformers possessing the necessary requisites as to construction features of the type and design.

A careful analysis will result in operating companies selecting transformers which while of higher initial cost, will prove a better investment.

Often with the increased load, especially when the motor load predominates, it is difficult to maintain fair voltage regulation. Some stations run separate circuits for the lighting load, thus separating the lighting from the power circuits. Good regulation will be obtained from the use of automatic feeder regulators, as will be seen from the two charts, Figs. 14 and 15, given herewith.

We will take up as the last point the question of aging. Aging of iron laminations has all these years been carefully studied by manufacturing companies, and at the present time the "eternal vigilance" has not ceased. Unless carefully guarded against inadequate iron, grievous results will follow. Poor iron affects the efficiency of the apparatus; it also influences the temperature of the machine. Sometimes the defect may not be evident at the outset, but will develop with time, and the aged iron, resulting in increased hysteresis loss, may cause the heating up of the iron to a dangerous temperature.

To keep track of the change in the iron it is well, whenever circumstances permit, that tests be made to verify the condition.

The aging of iron in many instances will explain abnormal rises of temperature with practically the same load. With artificial cooling the difficulty is easily overcome by increased

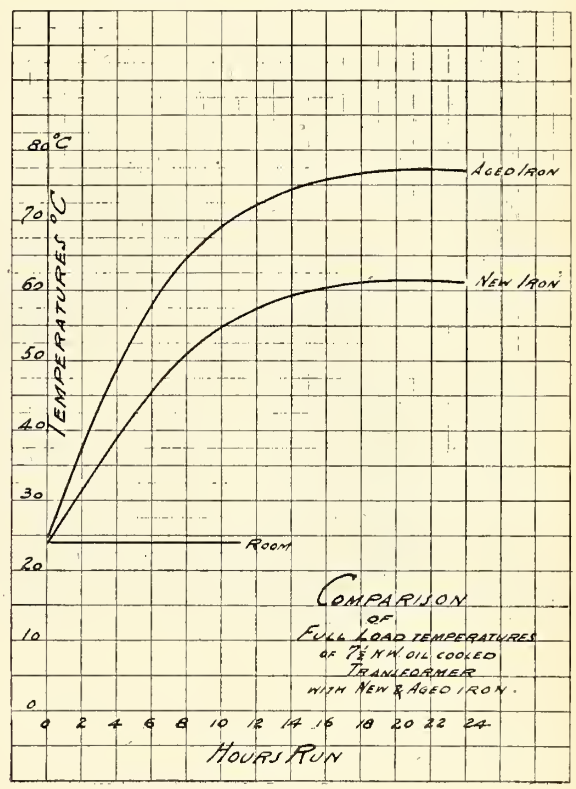


Fig. 17.

ventilation. It is well, however, to have full information with regard to the apparatus in use.

The phenomena of aging applies to all electrical apparatus and affects largely the central station companies on account of the extensive use of transformers. Inasmuch as aging increases with higher operating temperatures, it is preferable to purchase apparatus that will give the lowest temperatures.

To sum up then:—

Plants should be laid out with liberal provision for emergencies.

The performance of the apparatus under normal as well as emergency conditions should be thoroughly understood.

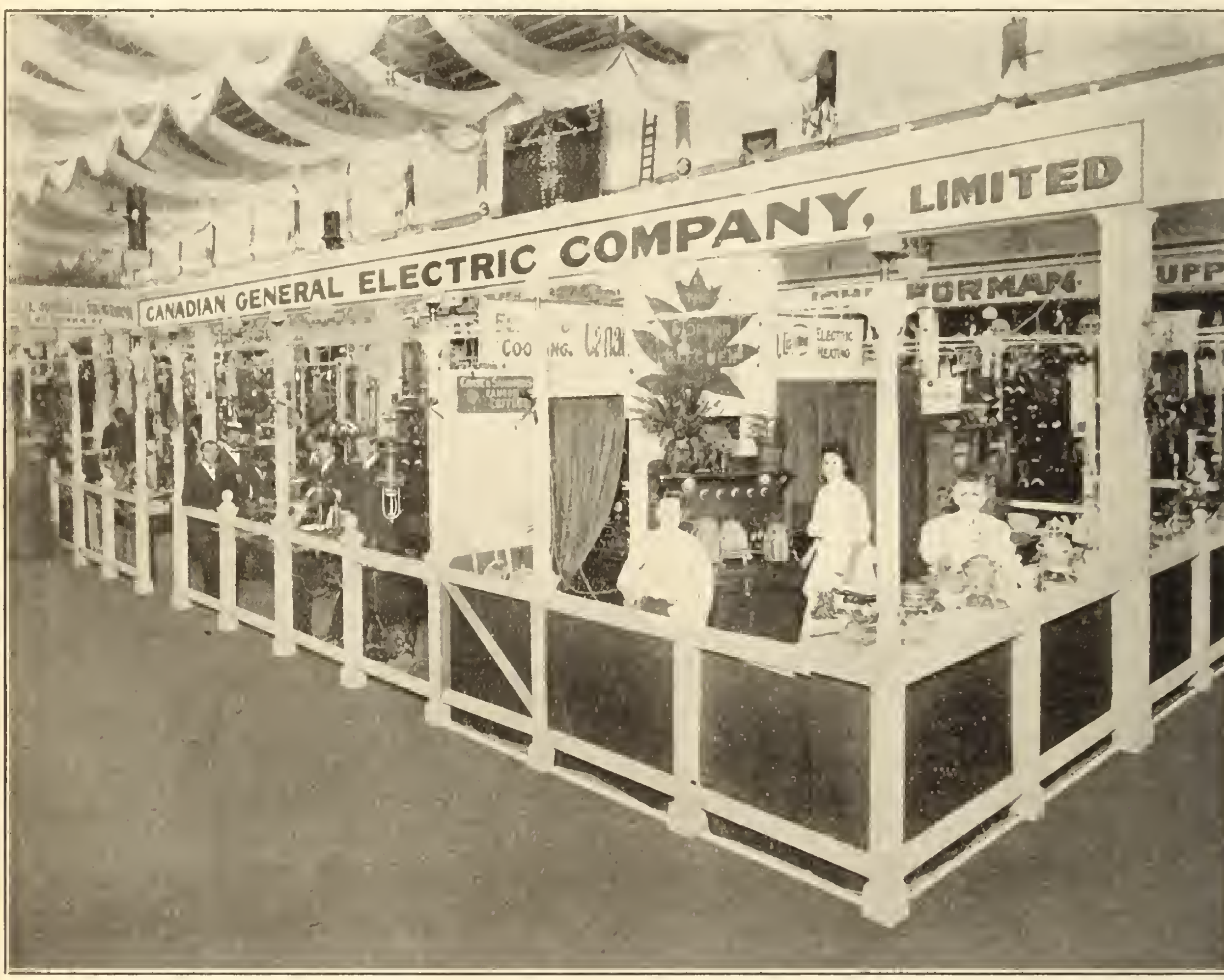
Small service transformers should be of the core type.

To insure proper parallel operation of transformers, records of transformers' impedance voltage should be kept.

THE ELECTRICAL EXHIBITION AT MONTREAL

The first Annual Show under the management of the Canadian Electrical Exhibition Company, Limited, which was held in the Drill Hall, Montreal, from September 2nd to 14th, was a success in every way, and the management is to be congratulated on the masterly manner in which it was organized and conducted to this end. Mr. R. S. Kelsch, first vice-president and managing director, was untiring in his efforts to improve where improvement could be made, and to advise where advice was required, but so thorough was his organization of the great event that after the opening day it went forward to success with a swing, and little or no trouble at all was experienced by the management.

The Drill Hall was very effectively decorated with white and electric blue bunting, caught with flag clusters and banners, whilst the stalls were resplendant in well-blended colors. The centre of the hall was occupied by a magnificent illuminated fountain, nestling in foliage, and the incessant play of the many-colored waters contributed greatly to the general effect. Under the brilliancy of the illuminations the hall presented a very striking picture. The wireless telegraph system as applied by Marconi attracted the visitor, and messages went hurling through thin air to the opposite end of the building. The wierd and wonderful dancing skeleton, installed by the Reynolds Dull Flasher Company, held one bound in amazement as he, of gigantic statue, performed the grotesque antics of the dance of drills, transforming himself at times into a representation of his Satanic Majesty with striking effect. While gazing on this uncanny creature the suggestion of the supernatural was strengthened by the moaning shriek of a siren, which combination bespeaks the hideous play of one of Dante's lost spirits; the DeForrest system of wireless telegraphy, operating under 20,000 volts, and sounding like the rattle of Mauser rifles in desperate combat; the crackling and hiss of the 60,000 volts static sign; the whir of turbine pumps, the throb of gasoline engines, the hum of motors, the buzz of fans, and the splash of waters all blended with the music of the orchestra in one grand harmony of the mysterious, the marvellous and the magnificent.



Canadian Electrical Exhibition—Exhibit of the Canadian General Electric Company.

The Show was officially opened on Thursday, September 5th, by Hon. Lomer Gouin, Premier and Attorney-General of Quebec, who was escorted by Messrs. W. McLea Walbank, president of the Exhibition Company; R. S. Kelsch, vice-president and managing director; J. W. Pilcher, secretary-treasurer; H. D. Bayne and J. A. Milne, directors. In a short speech the Premier declared the Exhibition open. He confessed himself surprised beyond expression at the remarkable strides that have been made in the development of electricity. H was exceedingly pleased, he said, at the evidence that Canada is well to the front in the matters connected with electrical development, and he hoped that the Exhibition would be such

a success that the promoters would not only be sufficiently well pleased with this year's work, but would feel that they could make it a yearly event.

It was uncertain whether the Exhibition should become an annual event, but results were so satisfactory that in all probability it will be held annually. The exhibitors almost unanimously expressed great satisfaction with the manner in which the Exhibition was conducted, and too much credit cannot be given the management for their efforts.

CANADIAN GENERAL ELECTRIC COMPANY.

Probably the most popular exhibit at the Show was that of the Canadian General Electric Company, Limited, largely owing to the fact that in their modern kitchen viands were given away and coffee served, all cooked by electricity. Every cooking device needed in a household was ably demonstrated by a corps of enthusiastic young ladies, who dispensed coffee with their descriptions of electric ovens, chaffing dishes, frying pans, disc heaters, cereal boilers, corn poppers, sad irons, water heaters, curling iron heaters, etc.

Next to the kitchen was seen a sewing machine driven by an electric motor, which may be attached to any house circuit. Portable electric drills for alternating current and a special fan for forcing a fine spray of water to humidify the atmosphere were among the novelties.

Tables were covered with samples of electric devices of all kinds; one table contained a large piece of crude rubber, which was used to insulate the many-colored finished cords and wires shown in profuse variety; another contained incandescent lamps in all stages of manufacture from the glass bulb and cellulose filament to the finished lamp.

Electric meters of many kinds were shown, all connected so as to show their actual working, one of which made a record on paper of the actual current used every minute of the day, and another in which it was necessary to deposit a ten cent piece before you could obtain an equivalent amount of current. At the further end was seen a train of seven direct current motors being operated from the alternating current circuit through the medium of a mercury arc rectifier. Distributed through the exhibit were a number of handsome stands, each containing three arc lamps of new and artistic designs.

The whole was lighted by groups of high efficiency incandescent lamps, including the well-known G. E. M. lamp of different sizes, and the new Tungsten lamp, giving a most brilliant light on a small consumption of current. The most attractive lamp was the German Nernst, emitting a beautiful white light and fixed in most artistic holders. Above were hung the new C. G. E. flaming arcs, burning 700 hours with one trimming.

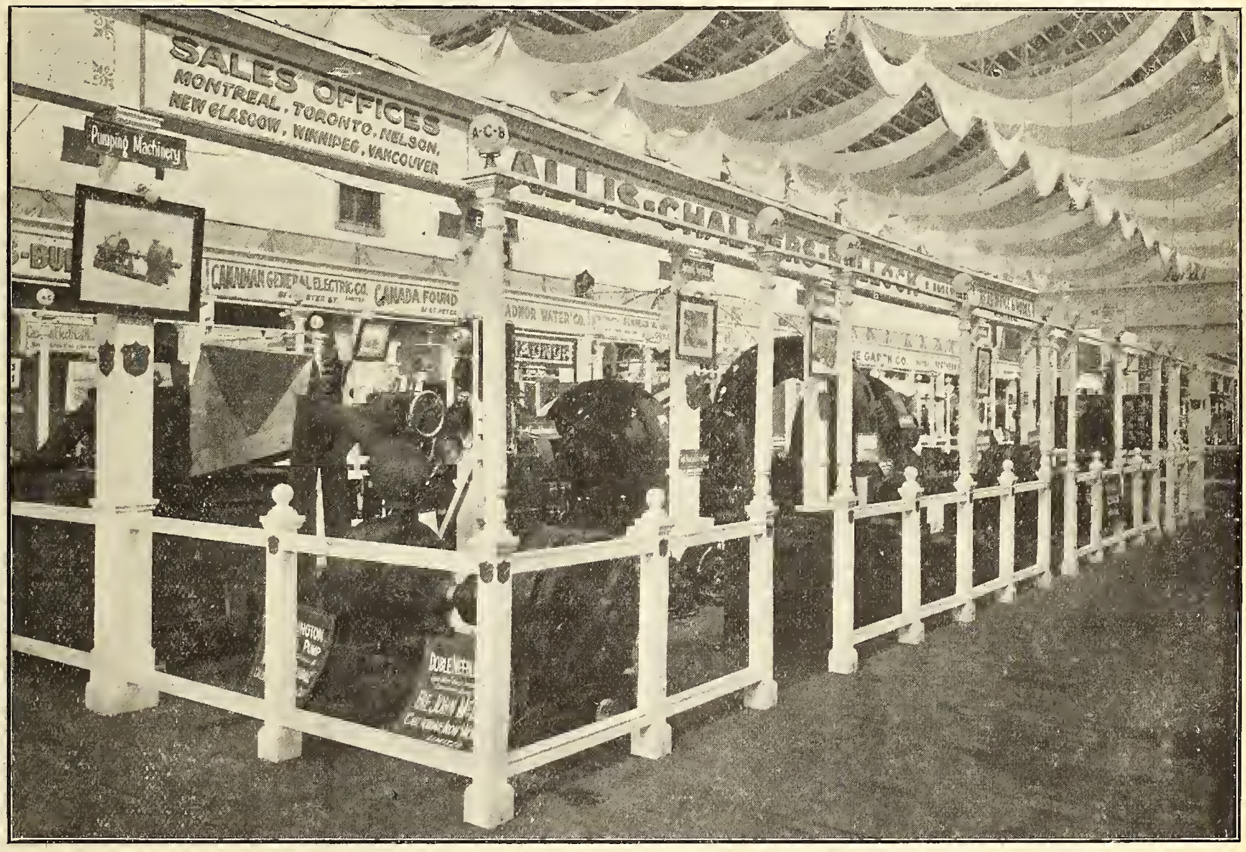
On another aisle was the overflow exhibit, comprising a full line of type H transformers, from 600 watts to 50 kw., and a mammoth 200 kw. for central station work. Here a 1,000 pound electric hoist for warehouses attracted much attention, lifting a steam pump, of which there were several shown, made by the Canada Foundry Company, Limited, as well as a complete line of Buda jacks and track drills.

ALLIS-CHALMERS-BULLOCK.

In contrast to many of the other exhibits, that of Allis-Chalmers-Bullock, Limited, Montreal, was intended more for the engineer and student. The company showed a belted alternator with a direct connected exciter in operation, two alternators built for driving by waterwheel, one unwound and the other partly wound, to show the method of fastening the field poles and windings; an engine type direct current generator, which can also be used as an alternating current generator; a number of polyphase induction motors and single phase self-starting motors, lighting transformers and other apparatus made at their factory in Montreal. On a small scale they reproduced the electric pump which has been in operation for the past couple of years on McTavish street. The capacity is only 360,000 gallons daily, as compared with 5,000,000 gallons daily by the city pump, but the unit showed clearly the method of operation.

The electric fountain, with the multi-colored rays, elecited a universal chorus of admiration. ''The man behind the gun'' in this case was an Alls-Chalmers-Bullock 5 horse-power induction motor driving a small Worthington centrifugal pump made by the John McDougall Caledonian Iron Works Company, Limited.

The ''process of manufacture'' is always interesting, but especially in the case of an article so commonly used as an electric motor. Realizing this, Allis-Chalmers-Bullock, Limited, brought a number of girls from their factory, and showed a regular winding department, where induction motors were built



Canadian Electrical Exhibition—Exhibit of Allis-Chalmers-Bullock.

up from the point where the wire is covered until they are ready to operate. This was not only one of the most interesting features of the Exhibition, but was also instructive to many of the visitors. They also showed a series of framed photos on a swinging rack illustrating the different products of their allied company in Milwaukee, and samples of the blading used in all Allis-Chalmers Company steam turbines. Both exhibits attracted a great deal of attention.

THE SUNBEAM AND HOLOPHANE COMPANIES.

The improvement in incandescent electric lamps and glass reflectors has never been more strikingly brought before the public than at the exhibit of the Sunbeam Lamp Company and the Holophane Company. The exhibit was made through the engineering department of the National Electric Lamp Association, and on account of the brilliant display attracted much attention.

Among the newer types of lamps shown were the Tungsten street series lamps. These were hung from a large arched framework and were of the 40 candle power 5 1-2 ampere type, operated nine in series on a 110 volt circuit. The lamps have a life of 1,000 hours and consume less than one-half the amount of energy consumed by old style carbon filament lamps. This saving was neatly demonstrated on a test board at the rear of the exhibit. A large electrolier surmounted the corner posts, and on a framework running between the posts were shown the latest forms of Tantalum lamps in round bulbs, known as Tantalum Meridian No. 1 and 2. These were of the 20 candle power 40 watt and 40 candle power 80 watt sizes, with frosted tips and with the Holophane reflectors, making units of pleasing appearance. Twenty and 40 candle power regular Tantalum lamps were also on exhibition in various forms of Holophane glassware. On each of the corner posts were four 80 candle power 100 watt Tungsten lamps, equipped with concentrating Holophane reflectors.

Suspended in the centre of the booth were several Holophane reflecting arcs or clusters, with 20 candle power Tantalum and 20 candle power and 40 candle power Metallized filament lamps. Holophone reflectors, globes, etc., were also shown on tables, provided with lamp sockets.

The attention of many visitors was attracted to a large wall case containing a number of Tantalum miniature lamps. These varied in candle power from 1-2 to 8 candles, and in voltage from 1.4 to 20 volts.

In the rear of the exhibit a specially constructed demonstrating room showed the increase of illumination produced by the use of Holophane globes and reflectors of various types.

The booth was in charge of Mr. W. M. Skiff, of the engineering department. Among the numerous representatives present were: Mr. B. T. Tremain, of the National Association; Mr. S. E. Doane, chief engineer of the Association; Mr. E. Irving, manager of the Sunbeam Lamp Company of Canada, Limited, and Mr. V. R. Lansingh, of the Holophane Company.

Canadian Electrical Exhibition—Exhibit of the Sunbeam Lamp Company and the Holophane Company.

THE CANADIAN WESTINGHOUSE COMPANY.

Of some of the large machinery seen at the Exhibition, the Westinghouse Company had in its booth a 1,500 horse-power 600 volt direct current railway type generator, built by them for the Montreal Street Railway, to be installed in their new power house at Hochelaga. This machine stands over 15 feet high.

A 2,500 kw. 46,000 volt transformer, mounted on a large base, was also one of the prominent features of this exhibit. This transformer was built on contract by the company for the Provincial Light, Heat & Power Company, and is one of five transformers of the same size to be used on their power development at Soulanges Canal.

Perhaps the most interesting feature of the exhibit was a so-called static sign, which was operated at a potential of 60,000 volts and illumined in lightning-like flashes the word "Westinghouse." The illumination by this sign was enhanced by a black curtain-like structure which surrounded the sign.

Among the smaller items of this exhibit was a variable speed alternating current motor of 15 horse-power, complete with its reversing controller, which motor was operating continuously throughout the performance. A line of various sizes of induction motors, ranging from 5 to 50 horse-power, was shown, which was likewise the case with a line of commercial lightning transformers up to 50 kw. Another piece of moving machinery representing a miniature power station was the operation of a small generator driven by a motor, with a small switchboard, and all the necessary instruments mounted thereon.

One of the first things that impressed the visitor upon entering the Exhibition was the brilliant light that radiated throughout the whole building, which was supplied by Nernst lamps, manufactured by the Canadian Westinghouse Company, Limited, Hamilton, Ont. The light was brilliant, without flicker, perfectly steady and of daylight quality. Nernst lamps are made in different sizes, from 50 candle power up to 500 candle power. There are three different types—indoor, dustproof, and outdoor, which meets all conditions of artificial light.

An important feature of the Canadian Westinghouse Company's exhibit was the demonstration of the company's unit switch system of multiple control. Generally speaking, this apparatus is not new to electric railway officials, but is especially interesting at this time owing to the tendency which now exists among these officials to handle their rush hour and holiday business in trains of two or more motor cars instead of putting on additional single cars, as has been the practice heretofore. With this system the heavy currents are handled entirely underneath the car, and therefore only a fourteen volt circuit is required upon the platforms, which permit of the use of a small controller 5 inches by 7 inches by 7 inches.

THE BELL TELEPHONE COMPANY.

The Bell Telephone Company had a complete system in operation in the building. The switchboard which was installed is the one generally used in the Bell system and had a capacity of forty local stations and ten trunk lines. When a call is made the number of 'phone calling is flashed before the operator at the central station, who signals exchange asking for desired number. When the connection is made by exchange the caller is immediately switched on by central.

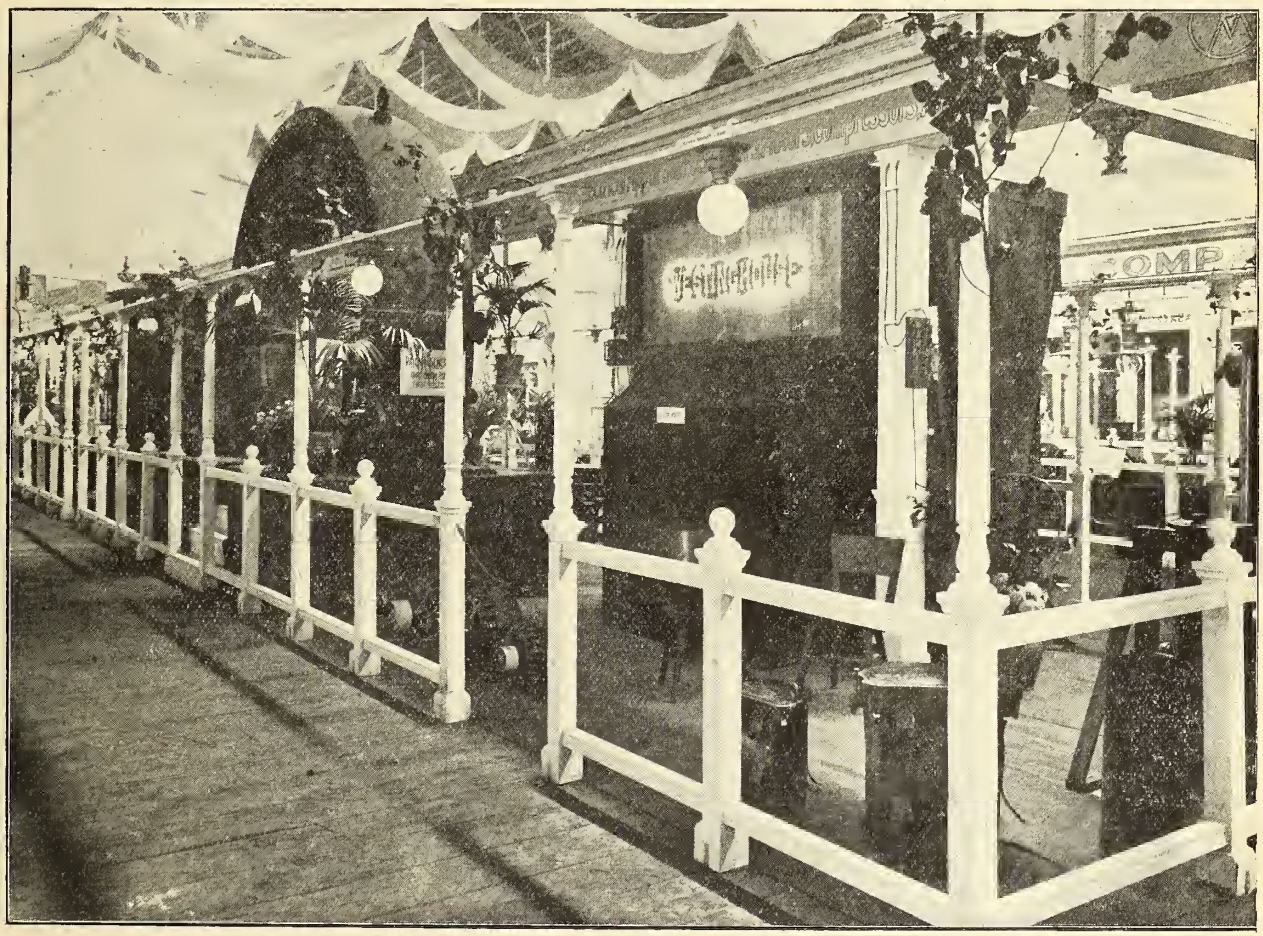
The advantages of this local switchboard in office and manufacturing buildings are quite clear, one being that communication may be carried on throughout the building on local lines without interfering with trunk lines, which might in some cases hinder important incoming business. Again, the responsibility of all messages is centered on the operator in charge, providing against irresponsible employes answering important messages. A special feature of their exhibit was the new condenser set, which bridges on the line with the initial set. This is very servicable to physicians and those expecting night calls.

THE DANCING SKELETON.

The Dancing Skeleton, installed by the Reynolds Dull Flasher Company, of Chicago, was the great drawing card of the Show, and proved to be a constant source of wonder and amusement to old and young. It was operated by Mr. Dull, general manager of the company.

The device that operated this dancing skeleton is known as a flasher. Flashers are designated by some particular term of expressing their class, but as this machine is the first of its kind that has ever been built, its class has yet to be given a name. It can be likened to an immense music box, electric switches, of which there were twenty-four in number, taking the place of the little tongues that produce the sound. The skeleton itself is divided into twenty-four circuits or clusters of lamps, each cluster representing some portion of the body, and these clusters are thrown on and off as may be required to produce the image desired. When one set of switches is thrown on to show a certain position of the figure, the other cluster is working alternately with one lot of switches, producing another position, which has the appearance of the image quickly changing from one position to another, which is true in one sense of the term and untrue in another. The object actually does change, but there is nothing moving about the construction of the object itself. The motions are made so rapidly that he appears to move, which is nothing more or less than a peculiar illusion somewhat on the principle of a moving picture machine. The flasher itself consists of an immense revolving cylinder, 13 feet in circumference, and driven by a small 1-20 horse-power motor. It makes about one revolution per minute. Attached to a side frame supporting this cylinder are twenty-two switches, arranged in two gangs for manipulating the various clusters of lights forming the different parts of his body for the different positions. On the face of the cylinder are small brass projections ranging from 1-2 to 6 feet long, which raise and lower the switches for any length of time according to the length of the brass projection. To produce the figure in one position it may be necessary to raise ten switches simultaneously. To produce another figure it may be necessary to raise six switches.

When one of these small switches is raised, that projection of the body is lighted for a certain length of time according to the length of the projection on the face of the cylinder,



Canadian Electrical Exhibition—Portion of Exhibit of the Canadian Westinghouse Company.

and when these projections are thrown off that portion of his body becomes dark and other portions are lighted in their place. This is what gives the appearance of the dancing skeleton.

THE PACKARD ELECTRIC COMPANY.

The exhibit of the Packard Electric Company occupied one of the large spaces on the central aisle and consisted of their well-known lines of type "G" recording wattmeters, transformers, incandescent lamps and induction motors. They had on exhibit one of 100 5-horse-power induction motors ordered by the Dominion Government for operating the lock gate mechanisms on the Welland Canal. They also exhibited a Jandus series A. C. system in operation, and the brightness and steady burning of these arc lamps made an attractive display, as well as being interesting to all central station men. The Gyrofan also attracted considerable attention.

The Packard Electric Company are also Canadian representatives of the Crocker-Wheeler Company and the American Instrument Company, and in their exhibit was a full line of American instruments—volt and ammeters of the portable and switchboard types. They had a 65 kw. Crocker-Wheeler generator in operation, besides an 18 inch ventilating fan outfit, and showed other well-known lines of the Crocker-Wheeler Company's manufacture, such as crane motors and small direct current motors.

Altogether the exhibit of the Packard Company was one of the most attractive in the hall and was visited by a large number of the electrical fraternity.

Mr. George C. Rough was in charge of the exhibit and was ably assisted by Messrs. R. A. Stinson, F. John Bell and J. E. Ryan, of the Packard Electric Company's staff, and also by Mr. C. L. Eshelman, of the Jandus Electric Company, Cleveland, and Mr. Frances DeGress, of the Crocker-Wheeler Company, New York.

THE MIDLAND ELECTRIC COMPANY.

Synonymous with Midland Electric Company are "Art, Grade and Endurance," and in reviewing the exhibit of this company we can well endorse the merits claimed by them. The public in general experienced a real treat in inspecting this exhibit, and no booth in the Exhibition attracted more praise and attention.

On interviewing Mr. Alvan Woolf, the managing director, he informed us that it has been a matter of many years' study and experience to cater for the wholesale trade in high grade arc electric supplies. All their goods are of European manufacture. From England they import high grade incandescent lamps, amongst which were shown their Wytelite, Weelite and Giantlite series. These on account of their faultless and scientific construction are claimed to give 50 per cent. more illuminating power than the ordinary lamps consuming the same candle power, besides being guaranteed for 1,000 hours. The "Linolite" method of illuminating show cases, store windows and pictures was fully illustrated, and it is not surprising that the quantity sold in Canada is increasing every month.

To describe the variety of electroliers displayed would require an artist's pen. Bronzes and terra cotta ware from Paris in all the latest and most artistic styles; bisque figures in Louis XIV. and XVI. style with gilt filligree work, while the celebrated "Amphora" porcelain and Vienna hand-finished and hammered brass portables with cut and art domes from Venice and hanging Oriental lamps from Turkey gave one the impression of being transported to an eastern fairy palace.

The Midland Electric Company are one of the largest importers of glass electric shades in Canada and control the output of three Bohemian factories.

Canadian Electrical Exhibition—Exhibit of the Packard Electric Company.

THE R. E. T. PRINGLE COMPANY, LIMITED.

The exhibit of the R. E. T. Pringle Company, Limited, was second to none, and visitors were amazed by the immensity of the lines handled by them. One practically found almost everything in the electrical line. The display of sockets, rosettes and receptacles, all of their manufacture, was indeed creditable, while the following firms were fully represented in their space:—The Faries Manufacturing Company, Decatur, Ill., fixtures, etc.; The Lemanquais Electric Manufacturing Company, Belle Mead, N.J., sectional panel boxes; Proctor Raymond Manufacturing Company, Detroit, Mich., electric bells; Standard Appliance Company, Chicago, soldering material; Adams Bagnall Electric Company, Cleveland, Ohio, arc lamps; Beck Flaming Lamp Company, flaming arc lamps;

Canadian Electrical Exhibition—Exhibit of the Midland Electric Company.

Canadian Electrical Exhibition—Exhibit of the R. E. T. Pringle Company.

Francis Keil & Son, push buttons and letter boxes; Promethens Electric Company, New York, cooking apparatus; Moloney Electric Company, St. Louis, Mo., transformers; Electric Goods Manufacturing Company, telephones.

The working exhibit of the Vulcan Electric Heating Company, of Chicago, was personally conducted by their president, Mr. F. J. Holmes, who demonstrated a line of soldering and branding irons, and the exhibit of the D. & W. Fuse Company, Providence, R.I., was in charge of their special agent, Mr. F. B. Killion.

Harvey Hubbell, Inc., of Bridgeport, Conn., had a working exhibit of pull sockets and other specialties in this particular line.

The "Ever Ready" electric novelties and flashlights, made by the American Electrical Novelty & Manufacturing Company of New York, were also interesting. This exhibit was under the special care of Mr. R. T. Smith.

The exhibit was in charge of Mr. Irving Smith, the company's sales manager, who was assisted by Mr. P. M. Walker and Mr. D. W. Massie, and several young ladies.

ants. Among some of the goods shown were the Connecticut telephones, which attracted considerable attention, being one of the finest lines of telephones in the market to-day.

American electric heating apparatus was also given considerable attention, great interest being shown in the line by the general public.

P. C. & W. annunciators were also given good space, as well as American transformers, for which this firm are Canadian agents.

Other goods handled and displayed were the Lima high and low tension insulators, Brookfield glass insulators, alphaduct, Chase-Shawmut fuses and cutouts, Johns Manville railway supplies, Sta-Rite spark plugs, Forman type H. spark coils, Trumbull switches and switch boxes, also the justly celebrated Sangamo recording meters, type E., which is a new mercury type and is proving its superiority over many other meters in the market.

EUGENE F. PHILLIPS ELECTRICAL WORKS.

In the exhibit of the Eugene F. Phillips Electrical Works, Limited, was shown almost entirely a full line of samples of

Canadian Electrical Exhibition—Exhibit of John Forman.

the different wires and cables manufactured by them. They do a large trade in bare copper wire and cables of all kinds for transmission purposes, also insulated cables for feeders for electric light and street railway work, and a general line of weatherproof, slow burning weatherproof and the smaller wires. The exhibit of trolley wire seemed to attract a great deal of attention, as it was put up exactly as it is sent out by them. Also the exhibit of square and rectangular magnet wires, especially the asbestos magnet wires, attracted general notice, and several wire manufacturers from the United States who were present at the Show stated that it was the finest asbestos wire they had ever seen.

This company was incorporated in 1889, and up to 1899 used about 16,000 square feet of floor space. They then increased this and in 1904 built their present factory. They have just completed a new addition to their factory, which now gives them floor space of 80,000 square feet. They have now a thoroughly up-to-date mill, equipped with the best wire drawing, braiding, cabling and winding machines that it is possible to secure. They intend going into telephone work, and

THE BENJAMIN ELECTRIC COMPANY.

The Benjamin Electric Manufacturing Company, of Toronto, had a unique display of their wireless clusters and other lighting specialties. Special fixtures shown were their arc-burst and the Holophone arc. These fixtures afford the same efficiency as an arc lamp with a twenty-four per cent. saving in current, and are being installed with great success in place of the same. The wireless cluster is a very unique device, taking the place of the old style box and socket fixture, requiring only the two circuit wires to light from two to seven lights, and giving a greater efficiency and being much more simple and durable. This exhibit was of especial interest to architects, electrical engineers, central station managers and the contracting trade generally.

JOHN FORMAN.

The booth of John Forman was very handsomely decorated and was in charge of Mr. D. C. Meloon, who was ably assisted by Messrs. E. A. Seath, G. D. Leacock and R. Mace, representatives of the firm. The merits of all the goods handled and displayed by this house were very ably described by the attend-

Canadian Electrical Exhibition—Exhibit of J. A. Dawson & Company.

Canadian Electrical Exhibition—Exhibit of the Eugene F. Phillips Electrical Works.

are now installing a machine for the purpose of manufacturing lead encased telephone cables.

J. A. DAWSON & COMPANY.

J. A. Dawson & Company, electrical and street railway supplies, 148 McGill street, Montreal, had one of the most tastefully decorated booths in the Show. Their exhibit contained a complete and varied line of electrical goods, required not only by central station managers and contractors, but also by the manufacturers and general public.

Amongst the numerous lines handled and shown by them were the Duncan line of specialties, including sockets, rosettes and lamp guards; the Keough cord grip, a device for use with show window and reinforced cord, permitting use of 1-8 inch socket with largest size of cord; the two ball adjuster, a perfected device for placing the light just where it is desired; the Couch & Seeley telephones for exchanges, private line, rual and intercommunicating; the D. & T. guy anchors; Macallen overhead and line material, Sterling varnishes, and Phone Eze telephone brackets. Another line which this firm handle is the Pacific electrical smoothing irons. This iron is now in use in several of the largest laundries, etc., in Canada, and has given exceptionally good service, the construction being such as to give a maximum of heat and very small current consumption.

Messrs. Dawson & Company also showed an exceptionally complete line of street railway material, including plug and soldered types of rail bonds, field and armature coils, controllers, brush holders, etc. Amongst this line special mention should be made of the Cronse-Hinds "Imperial" arc and incandescent headlights. The exhibit of this line attracted much favorable attention. The Bliss "Projectile" brand of gears and pinions also attracted considerable attention, as did also the new patented brush holders which the firm had on view.

The Consolidated Car Heating Company's heaters, for which J. A. Dawson & Company are Canadian agents, were also displayed to advantage.

Mr. J. A. Dawson was ably assisted by Messrs. W. A. Lewis, John J. Warren and J. L. Allan. Mr. Keyes, of the Consolidated Car Heating Company, Mr. Mack, of the Crouse-Hinds Company, and Mr. Prouty, of the Macallen Company, were also in attendance during the Exhibition, explaining to all those interested the special features of their particular lines of supplies.

True to the established custom of the house, Messrs. Dawson & Company took special pains to afford their customers and the public generally every possible attention during the Exhibition.

MUNDERLOH & COMPANY.

Munderloh & Company occupied the booth to the extreme right of the entrance. The first impression when one came to their booth was that of a mass of lights and colors and dazzling beauties of design. Beginning with the largest lights of the exhibit, the arcs, and coming down to the light that gives only a candle power or two, the display offered a most interesting sight for the man who either came to buy or just as a sightseer. In all there were between 180 and 200 lights in operation every evening. Bronze figures were shown in great array, with various means of distributing the light. Some of these were arranged with frosted lights, and some giving only a dim but artistic reflected glimmer. Dome lamps for the table, decorated in antique designs and patterns, made very beautiful effects. Some of these are designs are brought about by modern processes in the manufacture of the glass, which are both unique and attractive.

Other noticeable features of the Munderloh exhibit were heating irons for household, travelling and laundry use. The enormous voltmeter in operation recorded the voltage coming into the building. This instrument was a face-simile of Munderloh's line of portable instruments and received much attention from central station men. They also displayed a large cluster of their "Radium" incandescent lamps at the back, "Helio-Munder" arc lamps, multiple and in series, as well as their new very popular flaming arc lamps for street lighting in front of stores. Attention was called to their new "Munder" socket, which appeals to every electrician. This socket involves features strongly endorsed by the underwriters.

Their exhibit of telephones, cutouts and wiring supplies was also most complete.

THE LOCKE INSULATOR COMPANY.

The Locke Insulator Manufacturing Company showed a representative line of "Victor" insulators, bushings, pins, etc., including one of their new 100,000 volt insulators, a contract for 150 miles of which has just been placed with that company for the lines of the Stanislaus Electric Power Company, California. This insulator is described elsewhere in this issue, and will be of much interest to Canadian engineers, since such a radical increase in transmission voltage should have a great influence in the development of Canada's unharnessed water power. The company was represented by Mr. John S. Lapp, secretary-treasurer, and Mr. Walter T. Goddard, electrical engineer.

MONTREAL CORRESPONDENCE.

The principal electrical contractors all report that they are rushed with work. A good deal of this, however, is due to the usual faculty Montrealers have of letting things lie till the last minute. However, there is considerable new work, and trade can be called good, although money is tight and collections poor.

Wonders have not yet ceased! We have lately noticed in the daily press an advertisement of the Canadian Fire Underwriters' Association of Montreal asking for an electrical inspector. They are evidently about to move, although it has taken seven years to get this far. It is more than probable that the commission who reported on the state of the wiring in the streets of Montreal was the last straw. It may not be generally known that there is no official in Montreal representing the Underwriters in the manner that Mr. Strickland does in Toronto.

The Westmount Company have found that the generator which they originally intended to take the day load is now too small, and they are exchanging it for a larger one. They report good business and the plant seems to be holding its own, although as yet it is too early to pronounce on it financially. It was thought at one time that Westmount being primarily a residential suburb, their day load would be nil, but it seems they have secured the contract for the current required on a 100 h.p. motor used for pumping purposes, as well as some other motors, which makes the day load considerably better than was at first expected. Criticisms have been made on the garbage destructor by outsiders, but we are credibly informed that the destructor is doing excellent work; and, moreover, did it not do so, it must not be forgotten that Westmount must dispose of its garbage by incineration.

Canadian electricians, and especially the Montreal local fraternity, have reason to thank Alderman Sadler for his warm interest in them and in electrical matters generally. Alderman Sadler has held his seat for many a term and has always been interested in electrical matters, seen fair play, and worked with us generally to further electrical things to the utmost of his power. Would that we had more civic officials like him!

The daily press, in an intem inspired by the Electrical Workers' Union, states that there has been a big falling off in employment in Eastern Canada during the last few months, and that there are two men for every job offered in their line. So far as Montreal is concerned, both at the time this was printed, previous to it, and now, many of the reliable contractors cannot get half enough wiremen, in fact several electrical firms have letters from other towns asking for wiremen to be shipped out to them. The trouble is here that the local union men are not any more satisfactory, if as much so, as the non-union workers. Not that they are any of them idlers, but they are not competent to do the work, and in both classes nine men out of ten have a woefully inefficient kit of tools. In some of the large United States cities quite a number of such men would not be admitted to a union. It is admitted that competent wiremen in Montreal are slightly underpaid, but this is owing to excessive competition, there being about 126 contractors in the city, and also to the practice of the wholesale jobbers selling supplies to the public at the same price as they do to those in any way connected with the trade. Business is good and there is work for the men, but where is the profit for either the employer or employe as things are at present? The electrical trade of course will find its level like other trades some day, but until then it is bound to be more or less of a struggle all round for those at it in Montreal.

CANADIAN ELECTRICAL EXHIBITION—EXHIBIT OF MUNDERLOH & CO.

CANADIAN ELECTRICAL EXHIBITION—EXHIBIT OF MUNDERLOH & CO.

CANADIAN ELECTRICAL ASSOCIATION.

(Continued from page 314.)

results were surprising. The transformer nearest the load carried a hundred per cent. overload, and the others only about eighty per cent of their load. The line department wanted to improve the situation, and put up two more transformers on this pole in a hurry. They were put up and the transformers here only carried about twenty per cent. of their rated load. By fusing them heavily the transformers carried the overload for a few hours, and as soon as the load went off three poles were erected in a row near the first one and two transformers put on each pole, and in this way they divided the load equally.

I think it is of the utmost importance for operating companies to have current transformers with the split core—it is an inexpensive device and will save a great deal of trouble. Each transformer banked with another should be tested, and with these cable testing sets you only have to snap the split core current transformer on the wire without interrupting the service and you get a reading. It is very convenient to approximately check switchboard ampere meters should a current transformer burn out.

Another interesting point referred to in the paper is that men in charge of stations should know their limitations. The station manager or operating engineer might know what he would do in certain emergencies, but he is not always on the spot. It is essential that he should try to find out what troubles are likely to occur, make an inventory of them and instruct his operating men what to do in case such emergencies arrive. I know of a case where there were four generators in parallel with a very heavy inductive load on and the voltage was dropping. The field current was raised excessively to keep the voltage up at the end of the transmission line and the current became so high that it melted one of the field leads going into a field ampere meter. Consequently there was one quarter of the machines out of commission and the other three machines were made to carry the load by the operator being quick enough to raise the governors and run the speed away up and he kept the voltage in that way. It was disastrous to those with motors on, but they had to shut their motors off if the speed was too high, and the lights of the city kept going without the people knowing anything had happened. If the operator had not known that he could do this and taken the chance it would have meant a shut down of possibly an hour until the field connection was made again and the generators put in parallel. There are many cases like that which are very interesting and I have no doubt others here have had similar experiences.

Mr. H. S. Knowlton: I have just spent two or three weeks in New York looking into the electification of the New York Central terminal railway service. This company has issued instruction books, one for locomotive men and one for the handling of the distribution system, substations and power plants, giving information just along the lines your president has shown to be desirable. I have seen these books and they go into the question of emergency operation in great detail. The question of what to do in emergency is gone into in these books in such a way that every man at work on the distribution system or in the power plants and substations knows just what to do in case of trouble.

Without going too much into detail it seems to me that the same scheme carried on in the power plant of a large central station company would be desirable. A man cannot sit down and read a lot of rules after the crisis occurs, but if he studies them over when things are going well he is pretty apt to know what should be done when the emergency comes up. I believe there is a field for the instruction book in the power plant no less than in the handling of electric distribution appliances, motor cars and locomotives, and I hope the central stations will prepare some simple instructions for their men along these general lines.

The President: I am glad to know there is such a book. An operating man has no time to do any thinking when trouble comes. He simply has time to remember what he should do, and if he has not thought it out before he is apt to make some mistakes. I know a number of good operating men who try to figure out what they should do in certain emergencies, and they have it all planned out beforehand, so that when that particular trouble arises they simply have to remember the remedy. If when trouble arises a man has to think out a lot of complicated connections he will get confused and mix things. In the smaller plants there used to be a fundamental rule never to shut down—to burn up the machines and everything rather than shut down. But with the very expensive apparatus we have to-day it might be advisable to shut down rather than burn out the station.

I remember in a town not very far from here where when the station was started the operators were told they must not shut down on any condition whatsoever. If the curcuit breaker came out they must keep on putting it in. As a result the sub-station at the city end of the line took fire. The fire developed so quickly that the operators could not get to the telephone to send word and have the power shut down, and the power house man kept putting in circuit breakers for twenty minutes. The firemen were perfectly helpless, knowing it was an electrical fire, and they had to stand there twenty minutes until the man at the power house end stopped putting in the circuit breakers.

Mr. B. T. McCormick: One question Mr. Sammett raises is that of raising the voltage of a machine ten or fifteen per cent. to take care of the drop in case of a heavy overload. That is a good thing I think, provided the generator will stand it. In many cases if we compel a generator to do that for any length of time, say a day, it means we are going to sacrifice some of the inherent qualities of the generator, perhaps have a poor generator at the low loads, the normal voltages, while to obtain a higher voltage we would have to obtain a very straight operation curve, which would make the strain at the high voltage double that at the low voltage. But for a short time, say an hour, and working the generator that much harder, it is a very good idea I think.

Mr. Sammett: The suggestion of raising the generator voltage 10 or 15 per cent. is made, not for continuous operation, but only for as long a time as is necessary to restore normal operating conditions. The inherent regulation would naturally suffer under such increased generator voltage, but as long as a fair degree of voltage regulation is kept up at the receiving end, the main point of supplying current at normal voltage is attained.

The President: I know of a large operating company installing a number of large oil transformers, and with a view of eliminating the fire risk they are placing them outside in a lane. Do you know the effect of extreme cold weather upon a transformer? For instance, at Dominion Park, or other small power stations where it is a summer load and there is no winter load, supposing the transformers were left there with the current off—you would not want to pay for the leakage all the time—would the extreme cold weather of winter cause any effect to the oil, for instance, cause the paraffine to separate from the oil?

Mr. Sammett: All transformer oils in extreme cold weather precipitate paraffine, and with this precipitation the oil has not the requisite strength, and if the current were turned on afterwards some damage might be done. In installations for summer loads only, where small transformers are used, they would be generally removed when the load was discontinued and used elsewhere during the winter.

The President: But take a large transformer, say four or five hundred kilowatts, it would be considerable expense to remove that and take the oil out, and you would naturally leave it wherever it happened to be for the winter. Or suppose the current were only shut off for a few days at a temperature of ten below zero?

Mr. Sammett: That would affect it some.

The President: Would the oil automatically come all right again or would it have to be treated?

Mr. Sammett: The transformers, whenever possible, should be baked out on a short circuit, to evaporate any moisture the oil may contain, also to restore the oil to its proper condition.

Mr. Ryerson: In certain cases where we have a market, but not a large one, we are planning to install outdoor transformers not requiring constant attention. On a 60,000 volt circuit stepping down to 12,000 we find we can have them made self-cooling up to 200 kilowatts each.

The President: Are these placed underground?

Mr. Ryerson: No—on the ground under the line.

The President: So if the current were off during the winter that transformer would come down to the temperature of the air?

Mr. Ryerson: It is not intended that the current should be off. It is intended for continuous service.

The President: But suppose the fuse should blow out, or owing to some other condition the transformer should lose its current in extremely cold weather.

Mr. Ryerson: If the fuse should blow out and the current be shut off there would be such a howl we should have to get the current on again before any damage to the transformer could occur—the customers would soon let us know if anything of that kind happened.

The President: But suppose an emergency case. Would there be damage to the transformer if it were left 24 hours without current in very cold weather?

Mr. Ryerson: If left that way several days it would necessitate some drying out, as Mr. Sammett says, before the current could be turned on again.

The President: That would be rather a difficult operation out in the field that way.

Mr. Ryerson: Yes, it certainly would.

Mr. Sammett: The building of a line to take care of the larger load, with a normal drop when one line is out of commission, cannot be justified. Emergency conditions are of short duration. An hour, a day or two at the most, operated under emergency conditions, would not warrant the high expense in connection with a transmission line that would permit, under overload conditions, to have a drop of 15 or 20 per cent. It is preferable to increase the generator voltage, in order to compensate for the increased drop, especially when one considers the high price of copper.

It is generally understood that Mineral Seal Oil does not break up. In the instance under discussion, the oil was Mineral Seal Oil.

The President: Mr. Robertson, cannot you give us the benefit of your views on this matter?

Mr. Robertson: I have not been in the room long enough to be familiar with what has been said in this discussion, but in line with what I have heard in reference to transformers being left outside when not alive, I should be very much averse to leaving a transformer outside when disconnected, with the weather below zero, and should hardly expect it to operate afterwards without injury. I should think it would be better to take it off the line entirely, and store it or use it elsewhere. It might not do it any harm, but it frequently does, and I should not care to take the chance.

The President: I could conceive conditions where 500 kilowatt transformers might safely be left several days outside in winter without any current. In your opinion, if the transformer were so left out, should it be specially treated before the current was again turned on?

Mr. Robertson: That would depend upon circumstances. If the transformer would stand a ten thousand volt test, and was used on two thousand volts, I would not be very careful. But if I were going to operate the transformer at anything near its maximum voltage, I would be very careful how I started it again.

Mr. Sammett: If the transformers are kept outdoors, it is well to have them completely filled with oil, the oil filling the tank and cover. This would necessitate the connecting up of the transformer tank with a reservoir, placed above the transformer. With such an arrangement in the event of the current being off, there is no danger of condensation in the transformer. In connection with high voltage transformers, such a precaution is of the utmost importance.

Mr. A. A. Wright: My son runs a plant at North Bay, a pretty cold country. They run the plant only at night. In the day everything is off and tnere are no evil results to the transformers.

Mr. Sammett: That would have reference to the ordinary distributing work of 2,200 volts. At such low voltage they are not likely to have much trouble. But at higher voltages the difficulties would be much more pronounced.

The President: There must be lots of two thousand volt plants which merely operate at night and have the current off in the day time, and if there was no trouble in this way we should know more about it. The point is regarding larger transformers at a higher temperature and voltages. From your remarks I should infer that you are more afraid of condensation from the air than the low temperature separating the paraffine from the lighter portions of the oil. So it would seem it is not the low temperature you are afraid of but the condensation.

Mr. Sammett: Yes.

The President: I have in mind a gentleman who has had wide experience operating and he told me he had transformers running very hot of the ordinary corrugated case type. He put a half inch pipe around the transformers and drilled holes around it, so as to give a spray of water downwards, and found the trouble relieved at once. The transformers dropped twenty degrees, and after running this way for some weeks he was patting himself on the back for the way he had overcome the difficulty. But one day he noticed that the oil had risen four inches in the gage. He could not understand it until he found something had dropped up against the case at the back where the water struck it, and a spray went over the case into the transformer. They had to operate the transformer this way until the end of the week, and on the Sunday they shut down and put a glass tube in to get a sample of the oil, and on drawing the tube up they found four inches of water in the bottom of the case. The transformer had operated several weeks in this way without any damage. The water had not reached the coils, and they separated it without any trouble afterwards. These little points are very interesting. One would think the oil would naturally be damaged and would have to be thrown away. This is another case of an emergency where the men did the best they could and everything went all right.

Mr. D. P. Burke: I had a couple of transformers out of service two or three months during one winter and the oil froze up in the case. The following spring we put them in service and they have been operating ever since without any trouble. They were of 2,250 voltage, and we have never since had any trouble with them.

The President: The nature of the oil makes a great difference, what you could do with one class of oil would be impossible with another class. The paraffine in some oils will separate much quicker and easier than it will in others.

Mr. McCormick: Aside from the bad effect on the dielectric strength of the oil in changing, the paraffine collects on the cooling coils and prevents them conducting the heat as they should, or else stops the circulation and keeps the transformers hot in that way.

The President: I understand in tests of 12,000 volts switch oil, if the oil has been shipped in tanks under a low temperature it will not stand a high voltage test as well as if it had not been subjected to the low temperature, but that the oil regains its insulating properties when it has been warmed up. A gentleman who has had great experience in that line of work told me he used to build fires around the tanks and heated them up or put the oil in the transformer case and heated it in that way, and then it would stand the high voltage test all right. That treatment seemed to make the paraffine blend with the rest of the oil.

Mr. Burns: What temperature would they heat the oil to after it had been frozen?

The President: Probably a hundred and fifty degrees Centigrade, the flashing point of the oil is 300 degrees.

Mr. McCormick: If the oil was sluggish, due to the low temperature, it would not stand the same test that warm oil would on that account. The oil under the strain seems to move out of the road and make room for new oil which is not strained. You can see action of that sort going on if you watch it closely—when you watch the action you will see little ripples on the oil, showing how it moves.

The President: While we are discussing the effect of low temperature on oil I desire to state that I do not think that any person with a two thousand volt plant need be alarmed. It is with the ten, twenty and forty thousaud volt systems that you have to be careful. I know a firm that has a twenty thousand volt plant and they pay no attention at all to their oil, and they do not appear to have auy particular trouble in that directiou either.

We will now close this discussion and proceed to our next paper, which is one on "Three Wire Generators," by Mr. B. T. McCormick, who is well-known to most of you as the designing engineer of the Allis-Chalmers-Bullock Company.

Mr. McCormick: It is not my intention to take up the relative advantages of three wire generators and other apparatus designed for the same results. I would rather leave that phase of the matter for the general discussion. I would wish rather to describe the three wire generator as manufactured to-day, and bring out some of the salient points connected with its operation. You are, of course, all familiar with the old form of Edison three wire system, which consists of two generators, say two generators of 100 volts each or 110 volts each. These are connected in series and a wire known as the neutral wire brought out from the lead where connection is made. By connecting the two 110 volt machines in series we can obtain 220 on the outside wires and 110 between the neutral and either of the outside wires. The benefit of this is the higher voltage for motor purposes for power work, and at the same time the station operator can have the benefit of using lamps of a lower voltage, say 110 volts, which is better for lighting purposes as lamps are manufactured in Canada. At the same time you can secure the advantage of decreased copper loss corresponding to operation at 220 volts.

DISCUSSION.

The President: Three wire generators are machines about which the majority of us do not know much from actual experience. Personally I am very much interested in the three wire generators, as they seem to have advantages over the balancer set. During the discussion, we must learn from Mr. McCormick if the three wire generator has any bad features which would not be experienced with the ordinary balancer or with two independent 125 volt machines which could be regulated independently. Do you know any feature, Mr. McCormick, inherent in the three wire generator which is likely to give more trouble than having the two separate machines the field of which could be regulated independently by the operator?

Mr. McCormick: As I understand it your question is whether the old Edison two wire system is not better in some ways than the three wire generator. I cannot at the present time think of any redeeming features it has over the three wire generator. There may be some. Yes. One thing excepted, of course, that if the neutral wire will take care of it we can obtain better regulation with bad unbalancing than with the three wire generator, that is supposing the unbalancing was, say forty or fifty per cent.

The President: I am willing to admit that the three wire generator has many points of superiority over the two machines in series. At the same time I can see many places where two machines would be more flexible, for instance, on an underground system with a ground or short circuit. If you had a station of ten generators you could put them all on one side and burn off your ground, which you could not do with three wire generators. Another point: If your load should become very much unbalanced you take the machines off one side and put them on the other, so that you could carry say a full load on one side and one hundred and fifty per cent. on the other. You could not do that if your station was equipped with five three wire generators. On the other hand, with the three wire generators you have less commutator losses and fewer brushes to maintain. In working the three wire generators in parallel with an old Edison station can you foresee any trouble, Mr. McCormick?

Mr. McCormick: No, it is done right along.

Mr. Chambers: I should like you to discuss running a three wire generator in parallel with other machines. If one outside wire became broken or disconnected would that make a short circuit between the neutral and the other? Of course, with two machines in series if one is put out the other operates. But with a three wire generator, if one side is broken is the other side short circuited?

Mr. McCormick: You mean if one line is open—that would mean that the neutral wire would get more than it was intended to have.

Mr. Chambers: Yes, and would it burn out?

Mr. McCormick: It might.

The President: That could be overcome by having a circuit breaker or fuse in the neutral wire, so that if the neutral had to carry too much current back the fuse would protect it. That difficulty I think could be easily overcome.

Mr. Lambe: If that fuse should blow out and you are put out of business, would the loss go on to the lesser loaded side?

The President: As I understand the question, it was whether operating these machines in parallel with an old Edison station with say two 125 volt machines, so that if the fuse put in to save the transformers blew, the neutral of the system would not be gone.

Mr. Lambe: That is it. That counts a point against the balancer set. In moving machinery, unloading, etc., it is apt to go for the system and when it does your neutral is cut off and you are likely to damage a lot of lights.

Mr. E. J. Phillip: In operating shut wound Edison and also compound machines, there is no difficulty at all about running them in parallel. In the event of a circuit breaker coming out on one side, that machine will take care of a portion of its load, provided there are other machines with it. In the event of a three wire generator alone and the circuit breaker coming out on one side, it will try to carry the load on the other side, but the voltage will go up high, according to conditions. In the event of two three wire machines operating together, carrying approximately a full load, and the circuit breaker coming out on one side of one machine, the voltage will go off on that side and drop, because while the machine is designed to carry 25 per cent. on balancing, they will carry 50 per cent. on balancing, but the voltage will go off. It is not a matter of actual capacity. They will carry more than they were built for, but will not maintain the voltage, it may fall off fifteen or twenty volts. The spare breaker makes no difference. One machine may run on a line with a light load and a circuit breaker comes out, then it will carry the load on the other side.

The President: Where is the weakest part in the machine? Is it burning out in case of considerable unbalancing? Could that transformer capacity be increased by using a water coil?

Mr. McCormick: Yes, its capacity could be increased by the use of a water coil. Since it is so small in the first place, it would be better to increase the capacity of the transformer in the first place by putting in a bigger one.

The President: Suppose an engineer orders a machine with 25 per cent. unbalancing and should find his load change to say 50 per cent. out of balance. Could he put in a water coil or spray to get additional capacity for the temporary unbalanced condition, provided the slip rings did not heat?

Mr. McCormick: It would not necessarily be required. Supposing there were sufficient on the slipping rings to carry a larger unbalanced current. The water cooling would remedy that difficulty as far as the compensator was concerned.

The President: Supposing you have a three wire generator and want to run it as a two wire generator to work it on another system, the three wire generator being designed 125-250 volts, and operate it on one side of a 250-500 volt system, is is all right to leave the neutral switch open and use it as an ordinary 250 volt machine?

Mr. McCormick: Simply leaving the transformer across the rings, that is all right. The transformer will always take charging current, but there is no reason why it should not be left on, the neutrals being simply open.

The President: You would recommend putting a small four-pole switch in the leads going to the transformers?

Mr. McCormick: Yes, to take the transformer off completely. That is I believe the best way, as you save the charging current.

The President: And the armature is then to all intents and purposes an ordinary two wire machine.

Mr. Chambers: Would a three wire generator with a large unbalancing capacity be less efficient than one with a small—that is to say, if it is built for an unbalancing of ten per cent., is it more efficient than if designed for 25 or 50 per cent. unbalancing?

Mr. McCormick: There would be no difference in the design of the generator, whether it was designed for an unbalancing of ten per cent. or more. The only difference would be in the design of the transformer and in the size of the neutral wire. As to efficiency, that is another matter. The efficiency would be the same no matter what it was designed for, but the change in size of the balancing transformer might very slightly change the efficiency of the whole outfit.

Mr. Humphries: It seems to me that if you are only operating one unit on a system, there is an advantage in this. Given a power house with six units it would be far preferable, I think, to run an ordinary two wire D. C. machine with a rotat-

ing balancer set. You would only require one balancer set for a dozen of generators.

The President: Suppose that balancer set gave out, you would be without your neutral.

Mr. Humphries: I have operated a small plant. We never had more than one balancer set.

The President: But supposing that your only balancer set went out of business you would lose your neutral. What then?

Mr. Humphries: You would have to operate from the batteries for the time being.

The President: In stations in Canada we do not have any batteries—cannot afford them. The transformers of three wire generators, however, are inexpensive and seldom give any trouble.

Mr. E. J. Phillip: All our machines are supplied with the switches you mentioned. In our case if the load is pretty well balanced more than half the time the men do uot put these switches in. If the unbalancing increases they throw in the balance coil switches in another machine. The reason is, it is a gas engine plant, and, as an example, the gas might go off in quality in one engine pulling a good load, and so fall off in the others. Speaking of trouble with balancing coils, the engine running at full speed will carry nearly all the unbalancing, that is, the generator running at full speed. We have had the oil cooked in the balancing coil practically to molasses, but it did not affect the operation at all.

As fa ras running the machine as a two wire machine is concerned, all you have to do is to leave the balance coil switches out. Leave the brushes off the slip rings and the balance coil switches out on the board, and it is a two wire machine.

Mr. McCormick: I do not consider the fact that we have transformers any argument against the machine. They are very small and can be put in some place out of the way and considered simply as part of the return circuit—you can forget about them. Being about half the size of the small lighting transformers, they need little attention.

The President: I would like to ask Mr. McCormick a question that was not answered in last year's Question Box about these three wire generators. The question is that there was a 50 kw. three wire generator with a perceptible flicker in the lights, very similar to what might be the case if the periodicity of the machine were 25 cycles. Has it ever been observed that when the load is light or unbalanced the alternating effect of low frequency is shown in the lights from a three wire generator?

Mr. McCormick: In my experience I have not come across that. On a slow speed machine on which the frequency is low, and if we only have one compensator instead of two, such a thing as that might show up more strongly than in the high frequency machine with two compensators; where we get four phases the current distribution is much more uniform in the armature.

The President: This machine was running at a speed and had poles to correspond with 20 or 25 cycles of frequency, but there was a perceptible flicker on the lights. The commutator was in good condition, also the slip rings, and the engine was running quite smoothly. At the same time there was this perceptible flicker and a person might infer that the lights were off a twenty-five cycle circuit. Would you say that was inherent to the three wire machine or could it be from some other cause?

Mr. McCormick: Do you know whether it was of the two phase or single phase balancer type?

The President: No.

Mr. McCormick: I have never come across that trouble myself.

The President: You would think it possible on a single phase machine?

Mr. McCormick: Yes, it might be possible.

The President: You would not expect it on a four slip ring machine with two transformers?

Mr. McCormick: No, from the experience I have had I should not.

Mr. E. J. Phillip: In three wire generators under my charge I have known bad flickers. They are built to carry at certain load, but when starting them up, say, with a ten per cent. load, there will be a flicker. The speed of the engine is just the same. But as soon as the load comes on there is no flicker noticeable.

Mr. Lambe: That is with a normal speed?

Mr. Phillip: Yes, either balanced or unbalanced. All the lights flicker.

The President: Is it very perceptible?

Mr. Phillip: It is to an electrician, but would probably not be noticed by the general public.

Mr. Humphries: That is when they are balanced. You could test it by the power house to see if they were balanced. That experiment would be worth while making to see whether the trouble was caused by the third wire or whether it was inherent in the machine.

Mr. Phillip: My impression is that the current is fed into the machine iu pulsations. The current coming iu on the neutral wire eveu if almost balanced, there is the disturbing effect, the current as that lead is passing the brush and in the pulsations of the machine cannot flow into the armature of the machine in a continuous stream. The effect is that with the neutral wire the same as the segment of the commutator as it approaches and recedes from the brush there is a rising and falling pressure on the bar in its delivery to the brush on the collector ring and the outside wires wanting current must necessarily come in in pulsations, first one alone, then the other —that is what I think causes the flickering effect.

Mr. McCormick: If you opened that neutral wire with a balanced load it would prove that conclusively, there would be no question about it.

Mr. Phillip: If you opened the neutral wire you would be running your lamps in series.

Mr. McCormick: Then it must be the cause of it. It seems very reasonable if we only have two taps that the impedance to the armature circuit varies according to the position the tap occupies to the brush. If there were the same number of taps we would have conditions uniform. Therefore four taps would be much better than two, and with more it with do better still. That raises the question as to whether it would actually pay to put in more than four taps.

Mr. Lambe: You might find the explanation for the flicker in the working motion of your engine.

Mr. Phillip: Oh, no, there is nothing in that at all.

The President: Mr. Welbourn, have you had any experience in that line?

Mr. Welbourn: I am not connected with this, and cannot say. Some of the most recent work in England is on this system, and I know that satisfactory results are being obtained from it. They seldom think of the transformer question, but stick it away behind the machine. They are putting them in in 150 kilowatt sizes, and it requires no balancing transformer at all, as the whole arrangement is extremely simple and reduces the maintenance charge at sub-stations very materially.

The President: Mr. Robertson, have you had any experience with these three wire genrators?

Mr. Robertson: Not personally, to any great extent, but I have known for some time that a three wire machine with a light load was inclined to flicker. Not being particularly interested in the matter, I did uot try to find out why, but I thiuk a slight consideration should show the reason, and also why it stops with a full load, or when several machines are in multiple.

The President: Do you attribute it to the alternating current of the neutral?

Mr. Robertson: Yes. I never saw a modern machine that would flicker on a two wire connection, if in good order. That would mean that the voltage would go up and down, as the commutator bars passed the brushes.

The President: With a high bar on the commutator—that would cause a flicker also?

Mr. Robertson: Yes, but that would be another matter.

The President: With a high bar or low bar, there is lots of flickering on the lights.

The President: Is there any further discussion? If there is not I will call the discussion closed. We have three papers for to-morrow morning, and in order to get on with them we want to start as early as possible. We were late this afternoon, but I want to get through these three papers to-morrow morning. The first is by Mr. Delafield, on "High Tension Insulators." Then there is an interesting paper by Mr. Fleming on "The Nernst Lamp" and one by Mr. Robertson on "Incandescent Lamps." Each of these gentlemen has had a great deal of experience on their special subjects, and I am sure you will find their papers very interesting. It would be well for

every person to read these papers over beforehand if possible, and make marginal notes, so as to be able to come and discuss them properly.

The meeting then adjourned until the following day.

At the opening session on Thursday Mr. Clarence E. Delafield, of the high tension department of the Ohio Brass Company, Mansfield, Ohio, presented an interesting paper on "High Tension Insulators, from an Engineering and Commercial Standpoint." This paper, which created a lively discussion and brought out much useful information, will appear in the November number of THE ELECTRICAL NEWS.

The President then announced that Mr. A. E. Fleming, of the Canadian Westinghouse Company, would present his paper on "the Value of the Nernst Lamp to the Central Station."

Mr. J. M. Robertson, of the Montreal Light, Heat & Power Company, followed with a paper on "The Present Status of the Carbon and Metallic Filament Incandescent Lamps," which we are obliged to hold for a later number. The outcome of the discussion which followed the reading of this paper was that a committee was appointed to report on the new types of high efficiency lamps and their probable effect on the revenue of central stations, this committee to be composed of Messrs. A. A. Dion, J. J. Wright, J. M. Robertson, A. E. Fleming and A. L. Mudge.

The afternoon session was devoted to a very valuable paper by Mr. John Murphy, entitled "Anchor and Frazil Ice—A Simple but Effective Remedy for the Difficulties They Cause at Hydraulic Plants," and an illustrated lecture on "Methods of Illumination," by Mr. V. R. Lansingh, of the Holophane Company, New York.

EXECUTIVE SECTION.

A meeting of the Executive Section, comprising under the new constitution the accredited representatives of lighting and power companies, took place as announced in the program, Thursday afternoon, September 12th.

The first business was the election of officers, which resulted as follows:

President—R. S. Kelsch, Consulting Engineer, Montreal Light, Heat & Power Company, Montreal.

First Vice-President—W. N. Ryerson, Superintendent Ontario Power Company, Niagara Falls, Ont.

Second Vice-President—R. M. Wilson, Superintendent Montreal Light, Heat & Power Company, Montreal.

Secretary-Treasurer—T. S. Young, Confederation Life Building, Toronto.

Managing Committee—R. G. Black, General Superintendent Toronto Electric Light Company, Toronto; A. A. Dion, General Superintendent Ottawa Electric Company, Ottawa, Ont.; B. F. Reesor, Managing Director Georgian Bay Power Company, Lindsay, Ont.; J. J. Wright, Manager Toronto Electric Light Company, Toronto; Charles B. Hunt, Manager London Electric Light Company, London, Ont.; J. M. Robertson, Montreal Light, Heat & Power Company, Montreal, Que.; W. Williams, Gas & Electric Light Company, Sarnia, Ont.; H. O. Fisk, Peterboro Electric Light Company, Peterboro; J. W. Purcell, Hiram Walker & Sons, Walkerville; J. G. Glassco, Hamilton Cataract Power Company, Hamilton.

Mr. A. A. Dion brought up the question of the inspection of meters, pointing out that the Dominion Government was deriving a large revenue from the service and that the burden on the lighting companies was unnecessarily heavy. He suggested that the Association take some action with a view to inducing the Government to reduce the fees.

Mr. Dion's views were strongly supported by other speakers, and on motion of Mr. B. F. Reesor, seconded by Mr. J. W. Purcell, it was decided that a committee should interview the Dominion Government for the purpose mentioned. The President then appointed the following committee, with power to add to the number: Messrs. R. S. Kelsch, J. J. Wright, A. A. Dion, A. A. Wright, M.P., and J. M. Robertson.

At the closing session on Friday morning two papers were read, one by Mr. G. Percy Cole, electrical engineer for Allis-Chalmers-Bullock, on "Modern Lighting Transformers," the other by Mr. George H. Montgomery, solicitor for the Montreal Light, Heat & Power Company, on "The Responsibility of Electrical Companies for Accidents." Mr. Cole's paper created a lively discussion concerning the grounding of transformers, the general opinion being that it was good practice. Mr. Welbourn told of the English custom, which until about five years ago consisted of using cast iron plates four feet square, buried in coke. Mr. Montgomery's paper was listened to with intense interest, as it contained valuable information concerning legal points of interest to electrical companies.

The Question Box was next taken up. The Editor, Mr. A. A. Dion, suggested that in future it should be placed in the hands of a committee consisting of four or five members, who would endeavor to furnish answers to questions within a week or two. He believed that in this form the Question Box would become more valuable as a work of reference. The plan was generally approved and the matter referred to the Managing Committee.

The question of deciding upon the place for the next annual convention was left with the Managing Committee, and after votes of thanks had been tendered to the authors of papers and all who had assisted in any way towards the entertainment of the members, the convention adjourned.

CONVENTION NOTES.

The Allis-Chalmers-Bullock register, which is now looked upon as a necessary accompaniment of the Canadian Electrical Association convention, was printed and distributed four times. The last issue contained 282 names.

Wednesday evening the delegates were the guests of the Canadian Electrical Exhibition Company, a reception and luncheon being tendered in the Drill Hall on Craig street.

The electrical fraternity owned His Majesty's Theatre Thursday evening, when "The Gingerbread Man" was presented before a large audience.

The business sessions closed Friday noon. In the afternoon some of the delegates visited the Blue Bonnets race track, while the evening was devoted to a run through the city to Dominion Park.

The question now is, where should the 1908 convention be held?

The Montreal Street Railway Company generously furnished all members of the Canadian Electrical Association, the Maritime Electrical Association and the Canadian Street Railway Association with special coupon tickets good for the week. The Bell Telephone Company likewise extended the privileges of their local wires.

The Local Committee worked zealously for the entertainment of the visitors. It was composed of H. D. Bayne (chairman), Alderman Sadler, J. W. Pilcher, L. J. Belnap, Watson Jack, E. F. Sise and D. McDonald.

One of the unique souvenirs presented by the Sunbeam Lamp Company during the late Electrical Exhibition in Montreal was a re-fillable lamp, the invention of their manager, Mr. E. Irving. The process of re-filling the lamp in question is so simple that quite a few have been able to do the work themselves without the aid of skilled labor. Further details will probably be furnished regarding this invention on application to Mr. Irving himself. A pen knife bearing the inscription "Use Sunbeam Lamps" was also distributed to members of the Canadian Electrical Association.

THE NEW C. E. A. PRESIDENT.

Mr. R. S. Kelsch, the new president of the Canadian Electrical Association, is one of the most prominent electrical men in Canada. He has been engaged in electrical engineering work for the past twenty years, during the first ten years in Chicago, in charge of the large electrical properties in that city, and since April, 1897, he has been located in Montreal. He built and operated the Lachine Hydraulic system, remaining in charge of the same in the capacity of general superintendent and engineer until the Lachine Company was absorbed by the Montreal Light, Heat & Power Company in May, 1903. He then opened up an office as consulting electrical engineer, and the Montreal Light, Heat & Power Company immediately retained his services to consolidate the two immense electrical properties. This system was as different as day is from night—one system being known as three phase 60 cycle system, while the other was a two phase 66 cycle system.

In addition to this work, he has designed and constructed power plants all over the Dominion of Canada, amongst which are the following: The Kaministiquia Power Company, Fort William, Ont.; the Ottawa & Hull Power & Manufacturing Company, Ottawa; Sherbrooke Power, Light & Heat Company, Sherbrooke; Quebec Railway, Light & Power Company, Quebec; Brantford Electric Light Company, Brantford, Ont.; town of Napanee, Napanee, Ont.

THE HELION INCANDESCENT FILAMENT LAMP

The Helion lamp, recently exhibited before the Electrical Engineering Society at Columbia University, New York City, and also at a meeting of the American Physical Society, held in conjunction with the American Association for the Advancement of Science in New York last winter, is the result of a number of years' experimenting on materials for incandescent filaments by Walter G. Clark and Professor Herschell C. Parker, of New York City.

For the past three years the research work has been carried on in one of the research laboratories in Fayerweather Hall, and the inventors have for a number of years directed their

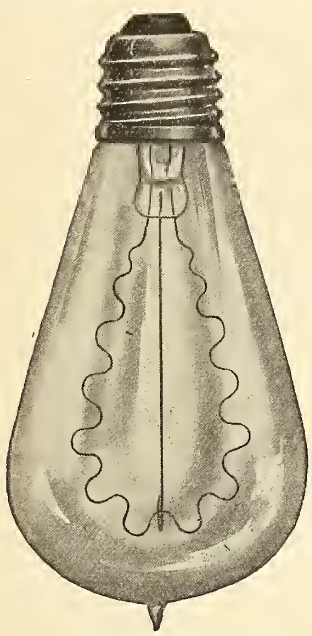


FIG. 1.—HELION LAMP

attention to the development of a material capable of withstanding a higher temperature than the carbon filament used in the incandescent lamp.

The carbon filament at present used begins to disintegrate or vaporize at a comparatively low temperature when that temperature is produced by the pasage of an electric current through the filament, the disintegration beginning between 1400° and 1600° (black body temperature), and by the time 1700° (black body temperature) is reached the disintegration is so rapid that the lamp fails either through the filament parting or through loss of efficiency due to the disintegration of the filament and the deposit upon the glass of the carbon shot off or vaporized from the filament. With the ordinary 3 1-2 watt carbon filament lamp, the efficient life of the lamp is taken at approximately 600 hours, for if the filament does not part at this time the efficiency has dropped to a point where it is more economical to pay for a new lamp than to pay for the increased current consumption per candle power of light delivered.

Another feature of incandescent lighting is the yellow color of the light, which does not give the same color values as daylight. For this reason colors appear very differently when observed under daylight and the incandescent electric lamp, and for the same reason a lamp giving a light more nearly the color of daylight is a more effective illuminant, as the human eye has become trained to observe and judge colors and illumination under solar light.

As the temperature of a solid source of light increases, the proportion of blue and violet rays increase more rapidly than the longer waves in the red and yellow of the spectrum. For this reason the red and yellow becomes less prominent and the light becomes whiter as the temperature increases.

The matter of selective radiation can also be utilized to this end when the selective radiation is in that portion of the spectrum which tends to produce a light approaching a white light. The Welsbach mantel is an excellent example of selective radiation in this portion of the spectrum. The Cooper-Hewitt mercury vapor lamp is another illustration of selective radiation, but from a gas. In this case the selective radiation is in the blue and green end of the spectrum and is lacking in the red and yellow rays, so that the light produced is very different from sunlight.

In the development of the Helion filament, Mr. Clark and Prof. Parker experimented with a great many substances covering practically every element whose physical properties gave any promise of success, in both metallic and non-metallic elements, and they became convinced that while some metallic substances would withstand the temperature necessary to produce an efficient filament, the low resistance of metals would necessitate that the filaments should be of exceedingly small cross-section in order to secure sufficient resistance to utilize in the lamp the voltage of an ordinary commercial circuit in a lamp of any modern or commercial size.

It is exceedingly difficult to produce a filament from the refractory metals of the small cross-section necessitated by the high conductivity of the metal, and if the filament is produced it is so attenuated that it is lacking in structural strength, so that a lamp made from this character of filament would be exceedingly fragile.

The inventors' early observations along this line have been borne out by the difficulty experienced in producing commercially a practicable metallic filament lamp for commercial voltage. In producing a lamp filament from material of lower conductivity or higher resistance than a metal, it is possible to use a greater cross-section for a given degree of incandescence at a given flow of current. Some early experiments by Mr. Clark indicated silicon as a material which gave promise of considerable success although the melting point of this material was comparatively low, but they found that under certain conditions they were able to produce the material in such a state that it withstood vaporization to a very high temperature and they also found that the radiation in the visible spectrum was greater than that of the ordinary carbon filament.

This increased radiation was not confined to one portion of the spectrum, but appeared to extend throughout the entire visible range and gave promise both in the matter of withstanding higher temperature and in giving off a greater percentage of wave-lengths in the visible spectrum than any other material with which they had experimented so far. Mr. Clark and Professor Parker have experimented upon this material for several years, and after repeated failures, they succeeded in producing the desired material in the form of a filament, possessing the necessary characteristics for use in an incandescent lamp.

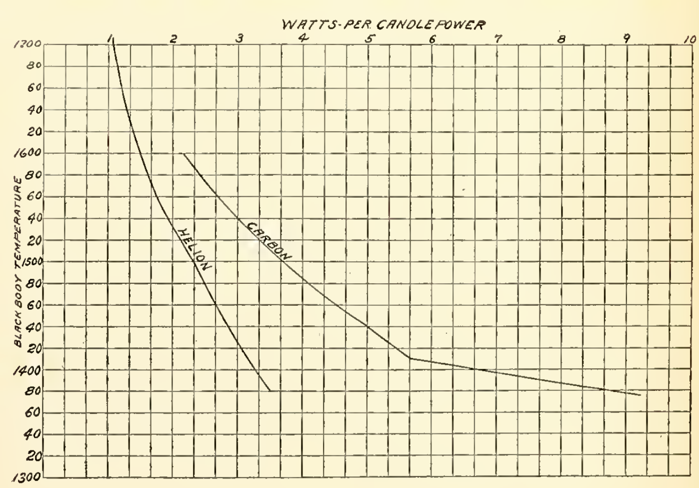


FIG. 2.

The method by which the filament is made is very similar to the one used in treating or flashing the ordinary carbon filament; as they use a base of carbon very similar to the ordinary filament on which they deposit a silicon compound out of gases which are introduced into a flask of the same general type as used in producing a carbon filament. As soon as the material begins to deposit upon the surface of the filament, the emissivity in the visible range immediately increases, and with practically no change in the current consumption, the bril-

ency increases very materially. The permanency or life of the filament at the temperature at which they operate is apparently dependent upon the amount of the compound which is deposited upon the filament, but when a sufficient amount is deposited, they still retain a resistance high enough so that they are able to observe 110 volts in a single corrugated loop. (Fig. 1.)

The inventors claim to have been able to produce lamps of this character for 110 volts consuming 30 watts and giving 30 candle power of light and withstanding a temperature of 1750 (black body measurement) without any apparent disintegration or blackening of the globe.

Another characteristic of the filament is that, while the material applied to the filament in their treatment has a negative temperature co-efficient of resistance and the carbon on which it is deposited has a negative temperature co-efficient, the completed filament exhibits this negative temperature co-efficient only to about 1400° (black body temperature), at which time it reverses, becomes positive and the positive temperature co-efficient increases very rapidly as the temperature increases, so that in this respect the filament has both the desirable feature of negative temperature co-efficient from the central station point of view and a positive temperature co-efficient at the temperature at which it is operated, which is valuable from the consumer's point of view, as it enables a lamp to better withstand increases of voltage than would be the case if the temperature co-efficient were negative.

The curve shown in Fig. 2 is plotted from candle power determinations on both the carbon filament and the "Helion" filament made by the Electrical Testing Laboratories of New York City.

The temperature determinations were made on the same lamps by means of the Fery absorbption pyrometer at Columbia University, New York City. It will be noted that the carbon filament lamp at 1380° (black body temperature) required practically 9 watts per candle power, while the "Helion" filament at this temperature required but 3 1-2 watts, at 1500° (black body temperature), the carbon filaments required 3 2-3 watts per candle power, the 'Helion'' filaments 2 1-3 watts per candle power.

The carbon filament lamp was rated at 3 1-2 watts per candle power. At this rating the temperature observed on tthe Pyrometer was 1510°; at 1600° the carbon filament lamp required 2 1-4 watts per candle power, the "Helion" 1 1-2 watts per candle power.

At this temperature, the disintegration of the carbon filament was so rapid that the efficiency began to fall off very materially before another reading could be made, but the "Helion" filament was carried up to 1700° (black body temperature), at which temperature it consumed 1.07 watts per candle power. In raising the temperature on these filaments from 1400° (black body temperature) to 1600°, the resistance of the carbon filament decreased 4 ohms, while the resistance of the "Helion" filament increased 5 1-2 ohms. From 1600° to 1700° (black body temperature) the resistance of the "Helion" filament increased 9 ohms.

Conclusive life tests had not been completed upon the low candle power filaments of small cross-section at the time the lamps above referred to were exhibited, but life tests made upon filaments of greater cross-section for higher candle power filaments at one watt per candle power operated up to in one case as high as 1,270 hours, and on a number of filaments upwards of 700 hours, and in each case the drop in candle power was very small, only about 3 per cent. In each case the lamp failed at or near the joint where the filament was united to the platinum leading-in wires.

They found that the cement used for uniting the filament to the platinum acted upon the filament, so for some time past they have been engaged in the development of a cement for making this joint, which will not act upon the filament, as the lamps of low candle power must necessarily have filaments of reduced cross-section, but the amount of the cement used is practically as great as though the filament were of much greater cross-section. For this reason a cement which acts upon and destroys the surface will destroy the small filament much more quickly than it does when used with a filament of greater cross-section.

This spring Prof. Parker and Mr. Clark in their experiments with cement discovered one which from experiments to date points to being eminently satisfactory, in fact experimental lamps produced in the laboratory have operated under laboratory conditions at an efficiency of one watt, and less than one watt per candle power for a period of time which encourages them in the belief that the "Helion" filament can now be made commercially practicable at an efficiency of one watt per candle power, with the added advantage that the light given by the "Helion" lamp is a pure white light, more nearly resembling sunlight than any artificial illuminant yet produced.

It is for this reason that they have adopted for the lamp and substance of which the filament is formed, "Helion," from Helio's Greek for sun.

A company of influential Canadian business men is being formed to manufacture the "Helion" incandescent electric lamp in Toronto, and it is expected that their factory will be in operation in the spring of 1908. We are informed they have already received offers of very large contracts for lamps, practically sufficient to keep the anticipated factory working to its full capacity for a year and a half. We understand the "Helion" lamp is covered by strong patents.

Mr. W. M. Campbell, 209 Stair Building, corner Bay and Adelaide streets, Toronto, is in charge of the new company's affairs in Toronto.

ELECTRIC CURRENT THIEF CAUGHT.

A matter of interest to electricians in general and electric light companies especially, was the conviction in Vancouver, B.C., recently, of William H. Davis for stealing electricity by diverting the current from the meter.

Davis was the proprietor of a private sanitarium where electric baths were administered. He had two contracts with the British Columbia Electric Railway Company, one for light at the usual lighting rates, and one for electricity for the baths and his electric sign at power rates, which was lower than the lighting rate, the latter having a minimum of $17 per month. This arrangement had been in force since last fall. The first month everything was apparently alright. The second month the actual cost of the amount used, according to the meter, was below the minimum rate and kept lower right along. The electric company became suspicious that something was wrong, but though its employes patronized the baths, they could not detect the real cause without exciting the suspicions of Davis, as the meter was too high up.

The method employed by Davis was the removal—presumably by jerking it out—of the potential wire entering the meter, and the insertion of a specially made wire plug. When he wanted the meter to register—as he would about the time the reader was expected around—he brought the bare end of the potential wire in contact with the bare portion of the plug; at other times the bare end of the potential wire rested against the insulatory part of the plug, and the insulation prevented the current passing through the meter. In addition to "fixing" the bath current meter, Davis had also practically re-wired the premises for lighting so that the current for the lights throughout the establishment was taken from the power current wires and was obtained at the lower rate.

For the defence it was claimed that Davis was not stealing or committing a criminal offence, as under the contract with the Electric Company the company had the right to make an average bill of charges. This plea, however, was not successful, and Davis was sentenced to six months on the charge of stealing current, and was fined $75 and costs on behalf of the Dominion Government on the charge of tampering with the meter.

In view of the rapid growth of the mining industry on the Pacific coast, the Tyee Copper Company, of Ladysmith, B.C., have decided to largely increase their smelter capacity. In accordance with this plan they are to install a first-class electrical equipment for the handling of the ore and they have already placed their initial order for this apparatus with Allis-Chalmers-Bullock, Limited, through their local agents in Vancouver. This order includes a 100 kw., 150 r.p.m., 240 volt, type "L" d. c. generator, direct connected to a 14 inch by 24 inch "Simple Reynolds Reliance Corliss engine, two 35 h.p. 220 volt standard A. C. B. single drum electric hoists, one 8,000 pound electric mining type locomotive, and one three panel blue Vermont marble switchboard.

SUSPENSION TYPE INSULATOR FOR HIGH-VOLTAGE TRANSMISSION LINE.

The Locke Insulator Manufacturing Company, Victor, N.Y., has designed and placed on the market a suspension type of insulator for high voltage transmission. The accompanying illustrations give an idea of the appearance and adaptability of this type of insulator. The insulator element is made up of two pieces of porcelain—a short inner shell and an outer flaring shell. These shells are tested individually at a potential of approximately 60,000 volts before assembling, and the assembled element is tested at a potential in excess of 90,000

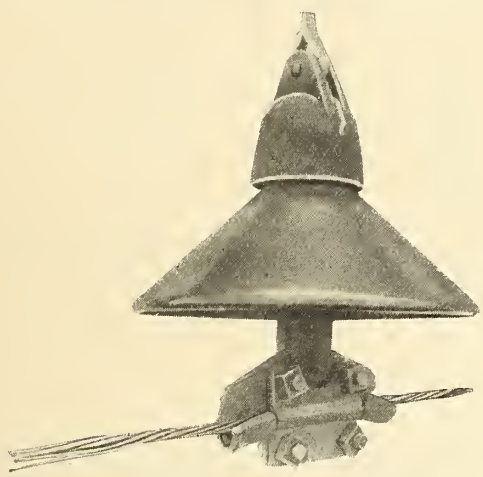


Fig. 1.—New Suspension Type Insulator for High-Voltage Transmission.

volts for a period of five minutes. The design of these insulators was developed by J. V. E. Duncan, electrical engineer for Sanderson & Porter, New York City, and W. T. Goddard, elec trical engineer of the Locke Insulator Manufacturing Company.

This insulator possesses many advantages over the regulatiou pin-supported type of insulator for about 75,000 volts. It has great mechanical strength and can be made at a lower cost. The transmission line may be run with one unit, and the insulating element increased at nominal erection expeuse

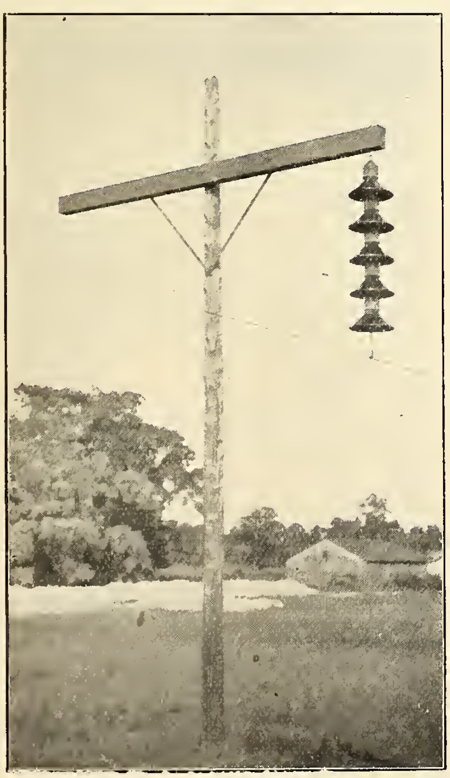


Fig. 2.—Method of Applying New Suspension Type High-Voltage Insulators.

to at least 100,000 volts, as the increase in the transmission voltage may determine.

In difficult localities one or more of the units can be carried about, thus taking advantage of the element of portability. The liability to puncture from damage is reduced because of the wider separation between the earth and the conductors. The insulator being made up of a series of individual elements, it is extremely unlikely that the breakdown of one element will throw the line entirely out of service.

The insulator is said to have an ultimate mechanical strength ranging from 10,000 to 12,000 pounds.

THE LATE MR. JOHN YULE.

In the death of Mr. John Yule, which occurred at his home at Guelph, Ont., on September 19th, a heavy loss was sustained by that city. As manager of the electric light and gas plants, he united with his professional knowledge a business acumen which made his services of almost incalculable value. The electrical fraternity will also feel his loss keenly, as his splendid work while actively connected with the Canadian Electrical Association is still a matter of frequent mention.

Born in Brechin, Scotland, in 1844, Mr. Yule entered upon his studies in gas and electrical works, starting with the Dun-

The Late Mr. John Yule.

dee Gas Company. Severing his connection with that company in 1881, twenty-six years ago he came to Canada and settled in Guelph, where he took charge of the plants of the Guelph Light & Power Company. His services in that capacity were so emiuently satisfactory that, when the city acquired the plant about five years ago, Mr. Yule was engaged as manager, as a civic official. His progressive policy was continued to the end. Sound and conservative in his business judgment, it is a tribute to him that in all his propositions, large as they sometimes seemed at the outset, he was met by a ready response which evidenced the trust reposed in his integrity and ability.

For many years Mr. Yule was prominently identified with the Canadian Electrical Association, of which he was president for two consecutive years. To him, perhaps, more than any other man, is due the credit of carrying to a successful issue the Conmee Act, which, notwithstanding the many attacks made upon it, represented wise and necessary legislation.

The late Mr. Yule was a man of many friends, a warm favorite in various social and business organizations. He is susvived by his wife and two daughters, Miss Yule, at home, and Mrs. (Prof.) Harcourt, of Guelph.

SPARKS.

The Laing Packing & Provision Company, whose large establishment is located on Mill street, Montreal, have renewed their contract with the Montreal Light, Heat & Power Company for the supply of all power service required to operate their refrigerating and packing plant. The Laing Company were perhaps the pioneer packing house in Montreal to operate electrically.

The Municipal Electric Commission has made a recommendation to the City Council of Ottawa that it be authorized to make the following offer to Messrs. Gilmour & Hughson, the owners of the Chelsea water power, that one-half the bed of the Gatineau river at the fall of Chelsea, with the right to take water enough from the river to develop 25,000 horse-power, be purchased by the city for the sum of $200,000, and that in addition the city agrees to build within ten years a dam across the entire river capable of establishing an eighty-foot head at the water power.

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MOONLIGHT SCHEDULE FOR NOVEMBER

Date.	Light.	Date.	Extinguish.	No. of Hours.
Nov. 1	5 20	Nov. 2	4 10	10 50
2	5 20	3	5 10	11 50
3	5 20	4	6 00	12 40
4	5 20	5	6 00	12 40
5	5 20	6	6 00	12 40
6	5 20	7	6 00	12 40
7	5 20	8	6 00	12 40
8	5 20	9	6 00	12 40
9	5 10	10	6 00	12 50
10	5 10	11	6 00	12 50
11	5 10	12	6 00	12 50
12	10 00	13	6 10	8 10
13	11 10	14	6 10	7 00
15	0 20	15	6 10	5 50
16	1 30	16	6 10	4 40
17	2 30	17	6 10	3 40
18	3 40	18	6 10	2 30
19	No Light	19	No Light	
20	" "	20	" "	
21	5 00	21	7 30	2 30
22	5 00	22	8 20	3 20
23	5 00	23	9 10	4 10
24	5 00	24	10 00	5 00
25	5 00	25	11 00	6 00
26	5 00	26	11 50	6 50
27	5 00	28	0 50	7 50
28	5 00	29	1 50	8 50
29	5 00	30	3 00	10 00
30	5 00	Dec. 1	4 00	11 00
		Total	....	234 30

A special meeting of the City Council of Edmonton, Alberta, was held September 25th to discuss the sale of the street railway to George Balfour, an English capitalist, provided a satisfactory offer is made. On account of the shortage of money to carry on the city, the municipal ownership is apparently falling through and practically all the aldermen are in favor of selling the street railway.

SPARKS.

The Cooper Gasolene Engine Company, of Winnipeg, is announced to have assigned.

The Sherbrooke Power, Light & Heat Company have offered to sell their plant to the city for $190,000.

Mr. Joseph Barrett, of Toronto, is promoting a power company at Minnedosa, Man.

The ratepayers of North Toronto, Ont., will likely vote on a by-law on January 1st to provide funds for an electric light plant.

The city of Grand Forks, B.C., has entered into a contract to purchase electric power from the West Kootenay Power & Light Company.

Mr. N. Simonsau, electrical contractor, Montreal, has obtained the contract for the electrical equipment of the new Montreal jail at Sault au Recollet.

The Blindman Electric Power Company, who have developed a water power on the Blindman river, are considering the operation of an electric railway to Gull Lake.

The British Columbia Electric Railway Company will shortly occupy their new car barns on the corner of Westminster and Fourteenth avenues, Vancouver.

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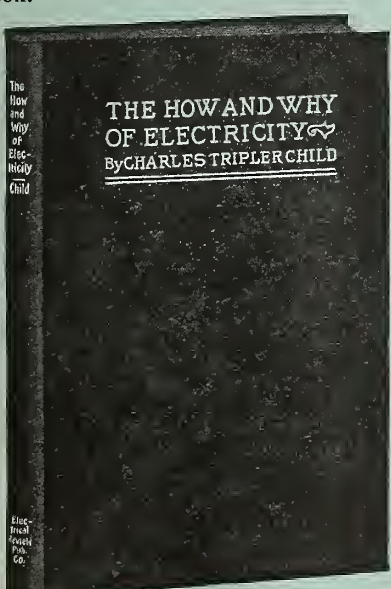

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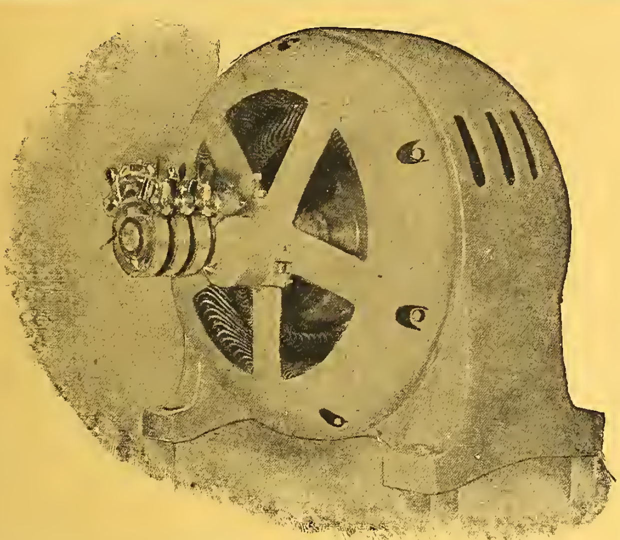

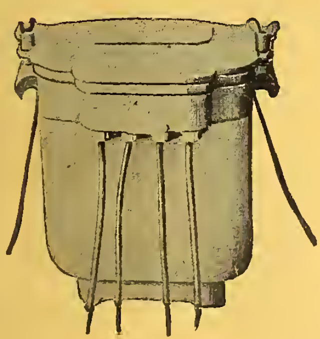

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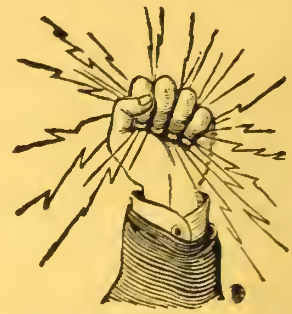

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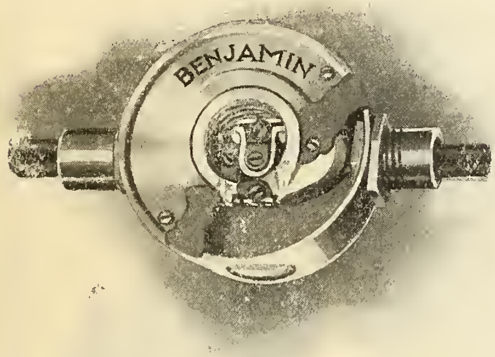

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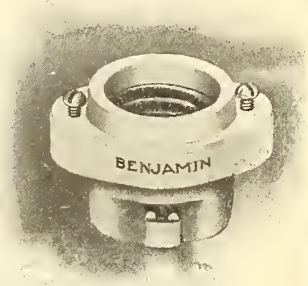
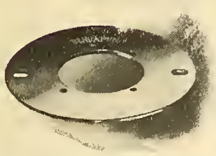


Cat. No. 6 B



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Cat. No. 3623

No Splicing of Wires

Bridgework Not Necessary

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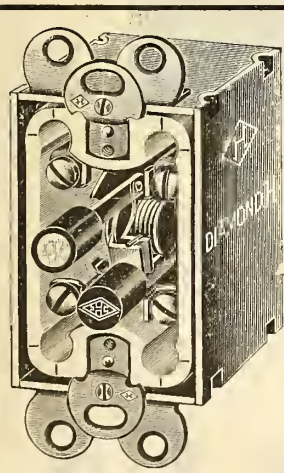

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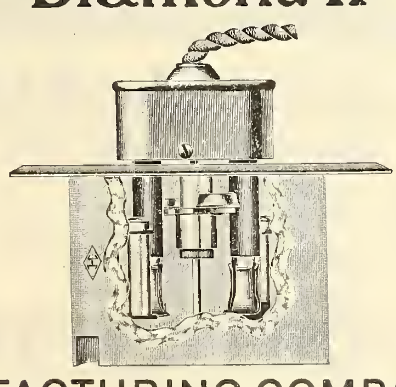

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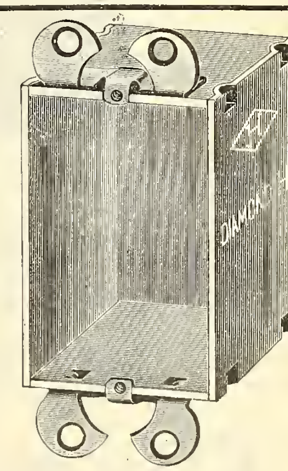

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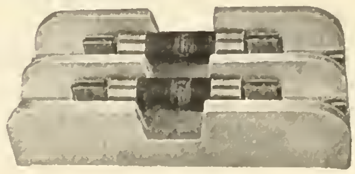
Twenty-four different sizes and styles



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Our Fuses are approved and listed by the Underwriters' National Electrical Association and are carefully tested and inspected before shipment.

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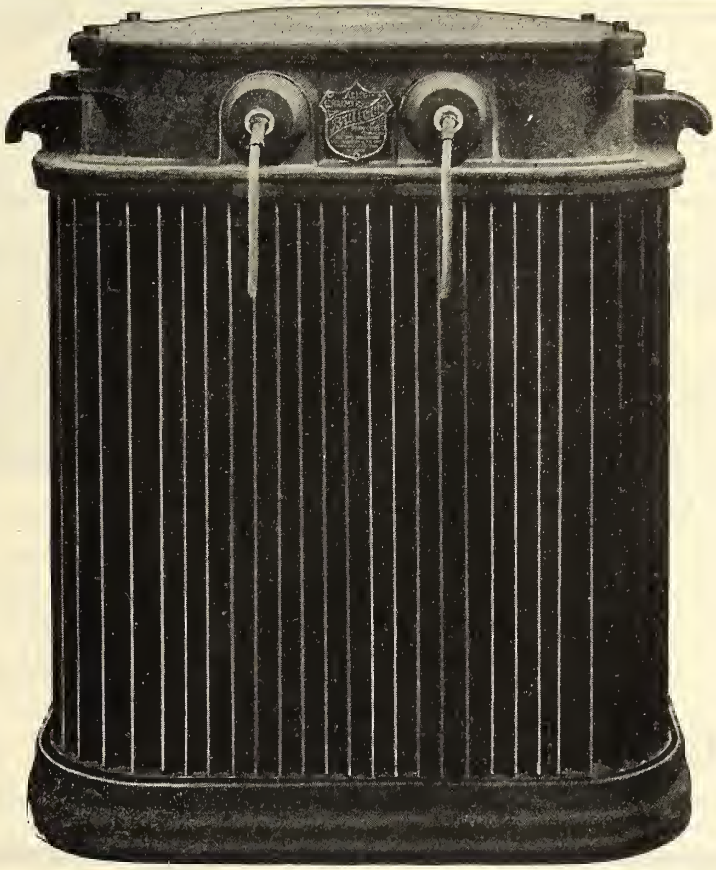

This is a view of one of our 10 k. w. Lighting Transformers. Bulletin 300 describes our full line of Lighting Transformers Among the good points are:

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2. HIGH EFFICIENCIES AT ALL LOADS
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NEW GLASGOW, N. S.—Telephone Bldg.
VANCOUVER—416 Seymour Street.

SPARKS.

The Northumberland-Durham Power Company commenced work last month on the development of Healey Falls.

The electric furnaces at the plant of the Electro-Metals, Limited, at Welland, Ont., were recently put into operation, and the results are said to have been very satisfactory.

The Britannia Copper Company, at Howe Sound, have recently installed two 30 h.p. 850 r.p.m. Allis-Chalmers-Bullock induction motors for the operation of their conveyor systems.

The township of Stamford, near the city of Niagara Falls, have decided to light the highways by electricity, and have entered into a contract with one of the lighting companies to that end.

Two 75 kilowatt belted type alternators with two generator panels, two lighting panels and a 25 light series a.c. arc light outfit, all of C. G. E. make, were recently purchased for the Hosmer mines at Hosmer, B.C.

The Department of Marine and Fisheries has been notified that the five new wireless telegraph stations, which the Government are erecting on the Pacific coast, will be opened for business on January 1st next.

The electrical equipment of the C.P.R. shops, Vancouver, has recently been augmented by the purchase from the C. G. E. Company of three 75 kw. transformers, and thirteen induction motors, ranging from 75 h.p. down to 5 h.p.

To meet with their increased business, the Shawinigan Lake Lumber Company, of Victoria, B.C., have recently installed a new circular saw and edger; these machines being driven by a 30 h.p. 900 r.p.m. Allis-Chalmers-Bullock induction motor.

The Tate Accumulator Company of Canada, Limited, has been incorporated to manufacture electrical accumulators and accessories. The capital stock is $500,000, and among the incorporators are Messrs. O. A. Tate, inventor, and James C. Stewart, manager.

The Hinton Electric Company, of Vancouver, B.C., are installing a 500 light electric plant at the Canadian Sulphite Pulp Company's mill at Swanson Bay, B.C. They are using a C. G. E. 25 kw. direct current belted type generator.

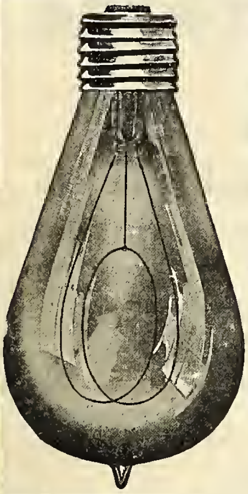
Messrs. Shannon Bros., operators of the Okanagan Lumber Company, Okanagan Landing, B.C., have ordered a 5 1-2 kilowatt direct current generator from the Canadian General Electric Company. This includes a panel switchboard giving them 110 lights.

The Columbia River Lumber Company, of Golden, B.C., have duplicated their present power plant. The new outfit consists of a 75 kw. 3 phase 60 cycle 2,300 volt generator, 4 kw. exciter and two panel white Italian marble switchboard, all of Allis-Chalmers-Bullock manufacture; also a 14 inch x 14 inch Robb-Armstrong horizontal engine.

The City of Victoria has recently purchased through the Vancouver office of Allis-Chalmers-Bullock a complete rock crushing plant, including a No. 5-D Gates breaker, a No. 5 single head 25 foot elevator, a 30 h.p. induction motor, and a complete set of screens. This outfit will be used in the extensive street reconstruction which is about to be begun.

The new power house for the Montreal Street Railway at the corner of Notre Dame street east and Raymond street is nearing completion. It is a building both dignified and refined, being constructed of brick with stone trimmings, the whole presenting a very pleasing appearance, following the usual style we have been used to for some time in buildings of this class.

The British Columbia Electric Railway Company of Vancouver recently received a 200 light series alternating current arc lighting outfit for the city of Vancouver. This makes a total of 850 arc lights in that city. The outfit was purchased from the Canadian General Electric Company. They have also ordered, from the same company, twenty-six "C. G. E. 67" four motor equipments.



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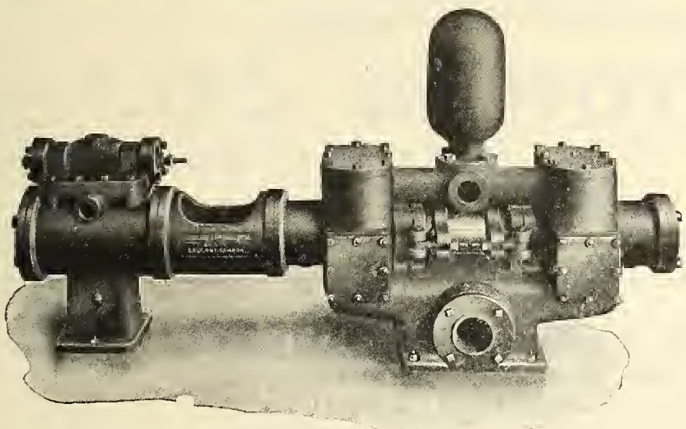

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Outside Packed Plunger Pumps

Specially Designed to Handle Hot Boiler Feed Water at High Pressure and also Gritty Water.

Send for Circular describing Pump, also Catalog of our lines mentioned in List below.

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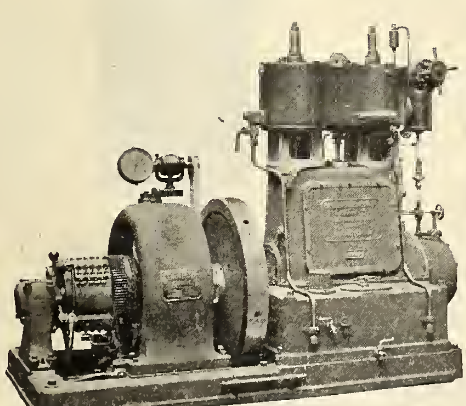

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ENGINES

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ELECTRIC POWER-LIGHTING, TRACTION AND MILL DRIVING, also CONDENSING PLANTS.

ADVANTAGES: Self-Lubrication; Simplicity; Strength; Experience; Low Cost; Reliability; Minimum Maintenance; Compactness; Good Governing; Durability; Maintained Efficiency; Quiet Running.

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CANADIAN

ELECTRICAL NEWS

& ENGINEERING JOURNAL

PUBLISHED ON THE FIFTEENTH OF EVERY MONTH BY

HUGH C. MacLEAN, LIMITED,

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 1st day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month for the succeeding month's issue.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, post free for $1.00 per annum. The price of Subscription should be remitted by currency, registered letter, or postal order payable to Hugh C. MacLean, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from United States and foreign countries embraced in the General Postal Union $2.00 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CHANGE OF OWNERSHIP.

With this issue of THE CANADIAN ELECTRICAL NEWS it devolves upon the publishers to announce a change of ownership. For the past seventeen years this journal has been owned by the C. H. Mortimer Publishing Company. The entire interests and good-will of this company were recently purchased by Mr. Hugh C. MacLean, under whose direction the publication of this journal will hereafter be continued.

Since its inception THE ELECTRICAL NEWS has aimed to promote the true interests of the important industry which it represents and to present at all times a record of current events as complete as possible. That it has satisfactorily discharged its mission is indicated by a large clientele of advertisers and subscribers, whose numbers are steadily increasing.

What has been accomplished in the past is but an inpiration for future effort. A determined policy of improvement, designed to produce the best electrical journal in America, will be pursued by the new management. These changes cannot be undertaken in a day or a month; they must necessarily be brought about as a process of evolution. Every issue, we hope, will plainly reflect improvement in the reading matter, the advertisements, the illustrations and in typographical appearance.

From advertisers and subscribers we solicit and anticipate a continuance of the support and co-operation which have been so generously extended in the past, and to them we promise our best services.

HUGH C. MACLEAN, LIMITED.

FAREWELL.

In saying a farewell word to subscribers and advertisers of this journal, the undersigned desires to express appreciation of the kindness and support received at their hands, and to wish them health and prosperity in the future.

C. H. MORTIMER.

The Grounding of Secondary Circuits.

Not so very many years ago the all-important question about any circuit, but particularly about a secondary derived from a high voltage primary, was, how well is it insulated. Then came a period of doubt, in which men asked each other whether or no it were not possible to have good insulation at the cost of various more or less serious risks which might otherwise be avoided. Then arose here and there direct advocates of grounding, their numbers being gradually added to until the question very soon will be, not how well is it insulated, but how well is it grounded. That this is the case is evidenced by that clause of the National Code which states that grounding may be made obligatory in any cases where those Insurance authorities having jurisdiction consider it advisable, which clause is almost always invoked in the case of secondaries derived, through one transformation only, from high tension transmission circuits, particularly if the installation be under the control of the Factory Mutual Association. This action is without question entirely justifiable, in fact it is now scarcely open to question but that all secondaries derived from potentials of approximately 1,000 volts and higher should be grounded, not in name only, but so thoroughly and so effectually that the passage through the ground circuit of even quite a large current cannot possibly give more than the normal potential of the circuit between it and the earth. The reasons for this are now fairly well understood, but the matter is so important that we repeat them in detail. They are only two in number, but they both affect most vitally the welfare of the whole electrical industry. They are first of all, that good effectual grounding obviates the risk to human life which otherwise always exists through the chance that a secondary circuit, normally at a safe potential above ground, may become crossed with some other line which carries a voltage dangerous to life. All secondary circuits are supposed to be safe, and therefore the appliances connected to them, such as switches, fuses, sockets, etcetera, are freely handled day after day by the many thousands to whom they furnish the conveniences of an electric service. Obviously any precaution, or arrangement, or device, which will turn this supposition into a certainty is most highly desirable, in fact it is more than this, it is absolutely necessary. That grounding a circuit will do this is clear from the consideration of the fact that when a line is so treated it is impossible

to find between any part of it and the ground a potential greater than that of the circuit itself, in fact, if a neutral point be available for the ground connection, even this pressure is reduced by 40 to 50 per cent., depending upon whether the system be polyphase or single phase. Grounding also reduces the danger from fire, in that any point of low insulation, which otherwise might very likely become a source of slow current leakage, gradually charring the surrounding inflammable materials until they burst into flame, soon becomes, in connection with a good ground on the system, a short circuit, thus bringing the protective devices into play.

There are naturally a good many ways of grounding, such for instance as attaching the ground wire to the water pipes at each customer's premises, by running a continuous ground wire throughout the secondary system, tapping the two together at frequent intervals, by driving pipes down until permanently moist earth is reached, or by burying ground plates in a charcoal bed, at a depth sufficient to ensure that the combination will always be moist. Local conditions will always have a large bearing on the particular scheme adopted, though if practicable one of the first two methods will doubtless prove the most reliable. The Waterworks authorities may in some cases raise objections to their pipes being so used, but a little explanation will doubtless remove all opposition, as there is no valid objection to the practice. This subject is considered so important by the N. E. L. A. that at their last convention, held in June last, in Washington, a report was presented and adopted in which the recommendation was made to the Fire Underwriters that grounding of all circuits of 300 volts and less be made compulsory. Action has not yet been taken on this, but in the meantime it is probable that, in all enquiries or suits relating to accidents or fires from electrical causes, the Courts will be more and more likely to enquire into the point as to whether or no the circuit was grounded, and to lay considerable stress on its absence, if such be found to be the case.

Lessons From the Exhibition.

When one hears of an Electrical Exhibition somehow or other nearly everybody pictures it as a collection of large and powerful machinery, rated not even by hundreds but by thousands of horse-power, and designed to give nothing but the very highest of potentials. Contrary to this general understanding, the recent Electrical Exhibition in Montreal was essentially an exposition of the materials used in everyday commercial and household life, in other words it was mainly a display of the consuming device as opposed to the generator. In this way it performed a very valuable function, namely, that of bringing before the public the great host of small articles which are now available for their use, and which are so undoubtedly meritorious that in numerous cases they have to be offered but once in order to ensure their immediate adoption. It goes without question that hundreds of visitors saw electrical articles of which they never before had even heard, a large proportion of them going away with the fixed determination to equip themselves therewith as soon as they conveniently could do so. More than this, this interest was not by any means confined to the lay public, the delegates to the C. E. A. convention being apparently just as much interested as anybody else, though of course more or less of the material was very familiar to them. On the contrary, it was all exceedingly novel to a very large percentage of the general public who attended, and without question will prove to be the means of introducing into ordinary commercial and household work many electrical time and labor savers which would otherwise have remained in comparative obscurity for some time to come.

Surely there is a lesson to be gathered from this great manifestation of interest, and that is that in the first place there is still a tremendous and unexplored field for the sale of electrical energy among stores and dwelling houses, and secondly, that it is up to the central station manager to make a very serious effort to develop this field and make it yield him the return which is surely his if he will but cater to the demands. All over the United States the distributing companies are conducting energetic and very comprehensive campaigns towards this end, in addition to the ordinary sales methods of newspaper advertising and show windows, making free use of special literature and demonstrators. It is of course impossible for every company to issue its own monthly bulletin, or to keep a demonstrator permanently employed, but flyers enclosed with invoices, an attractive display of apparatus in its own offices, and a demonstrator occasionally, for say a week at a time, are surely legitimate expenditures for even the smallest generating stations, providing of course that they are operating a day circuit. If not, there is practically no use in wasting thought over the matter, because in the first place they are obviously not in a position to cater to the trade, and secondly because even if they could secure it, it would lose a large part of its value to them by coming on simultaneously with the lighting load. In other words, the output which can be placed in this field is valuable, not only because it represents just so much more income, but also because it is off the peak. In Continental Europe and in the States this field, consisting for instance of small motors for retail store use, of illuminated signs, and of household heating and cooking devices, to say nothing of those for commercial use, is being actively exploited. There is absolutely no reason why it cannot be done in Canada, and with equally satisfactory results. The situation is very akin to that presented by street railway parks, the attractions of which frequently creating enormous traffic where before there was perhaps not even a rail. So in the present instance, without doubt the demonstrating and advertising of appropriate goods will create a load among sections of the community which at present are consumers of light only, this added output being peculiarly desirable in that it is essentially a day load.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—Why do nine B. T. chloride cells show only seventeen volts, while each cell shows two and one-quarter volts. Specific gravity 1170, charging rate 4 to 8 amperes. Should the framework of the positive plates become black and remain so?

Answer.—The reason for the apparent discrepancy in voltage is probably that the 2 1-4 volts per cell is that given by each cell while you are charging, or immediately after the charging has been stopped, whereas the 17 volts of the battery is the potential which you get after charging has been stopped for some appreciable period, say 5 or 10 minutes, or after some little discharge load has been put on it. This is due to the fact that a battery which takes say 2 1-4 to 2 1-2 volts per cell to fully charge it does not show this voltage after you stop the charging, the potential per cell dropping almost immediately to about 2 volts or even a shade less. The positive plates become darker and darker as the charge progresses, until they are a very rich chocolate brown, almost approaching a black, when the cell is fully charged. During the course of the discharge they become gradually lighter and lighter, the process repeating itself for each charge and discharge.

Question No. 2.—Would you please mind explaining to me the difference between a reactance coil and a constant current transformer. For lighting streets with arc lamps, which do you recommend?

Answer.—The main difference between them is that the reactive coil is a choking coil pure and simple, so that the primary voltage must be at least equal to, if not greater than, the total voltage required by the lamps. This limits the number of lamps per circuit which can be operated off a given primary voltage. The constant current transformer, on the other hand, transforms to any potential required, so that any number of lamps can be run in series off it. We would recommend the reactive coil for circuits not exceeding say 25 lamps, which can be run direct off 2,300 volt primaries, because it is much cheaper than the C. C. transformer. The latter, though, has the advantage of completely insulating the arc circuit from the primary mains.

Question No. 3.—I want to get an alternating current from a small bipolar generator which we are operating. It runs at 1,900 revolutions per minute, and gives 110 volts. Would you please advise me how to connect the slip rings, and what the voltage and frequency of the alternating current will be?

Answer.—The slip rings should be connected to any two opposite points in the armature winding, either at the commutator or pulley end, whichever affords you most room for the rings. The alternating voltage in a single phase rotary converter, or double current generator, is 71 per cent. of the direct current potential, so from your machine you will get 110 $\times$ .71, = 75 to 80 volts D.C. The frequency will be

$$\frac{1900 \text{ (revs. per min.)} \times 2 \text{ (number of poles)}}{120 \text{ (alternations per second)}} = \text{Cycles};$$

$\times 2$ (number of poles): cycles, which reduced is 31 2-3.

Question No. 4.—I am running two series arc transformers, each carrying two circuits, what I want to know is can I operate all the lamps off one circuit, and will it do any harm? What changes will I have to make to do it?

Answer.—You can operate all the lights in one circuit, or you can divide the total capacity into any two proportions that you desire, and the transformer will carry them perfectly satisfactorily. No changes of any sort are necessary other than simply moving the lamps from one circuit to the other, though if you put them all on to one you must short circuit the remaining circuit by a jumper. No harm whatever is done except that you increase your line potentials and thus the liability to grounds, crosses, etc. The increase in pressure will be in direct proportion to the change you make, for instance, if you are operating two 37 or 38 light circuits you will have about 3,000 volts per circuit, and this is the maximum potential existing in the circuit or the apparatus, except, of course, if the circuit should open. Now, if you put 60 lamps on to one side, and 15 on the other, or the whole 75 on to one circuit, you would get maximum potentials of 4,800 and 6,000 volts, respectively, which obviously is a greater strain on the equipment. In fact the double circuit transformer is so built largely in order to reduce the maximum potentials, thus lessening the strains on the apparatus and lines, and minimizing the chances of trouble.

Question No. 5.—In a three wire system, supposing that I have one side fully loaded, and the other with nothing on it, will I raise or lower the voltage on the unloaded side by putting lights on to it, and how will it affect the other side? In making some measurements the other day I found that putting on load raised the voltage on both sides, which seemed very funny.

Answer.—The results you get under the conditions you describe will depend upon the relative resistance of the neutral and the two outsides. If it is just the same size as the two latter you will not affect the voltage of the lightly loaded side, when you add lights to it, except of course, you load it until it has more on it than on the other. If the neutral be smaller than the outsides the voltage on the lightly loaded side will rise as you put lights on it, if it is larger the converse will be true and the voltage will fall. In any case the effect on the heavily loaded side is to raise the voltage on it as you load up the other side, until with equal loads the two potentials will be equal. The foregoing assumes constant voltages at the source of supply, but if you are supplied from one transformer connected three wire you might get such results from it, depending on its internal connections, as to absolutely overshadow the drops in the secondaries. For instance, there are transformers on the market which with full load on one side and none on the other will raise the unloaded side 12 per cent. or 15 per cent. above normal voltage. Obviously in such cases the differences between the voltages of the two sides with varying loads depends not on the drops in the wiring, but on the way in which the transformer acts.

THE ELECTRICAL EXHIBITION AT MONTREAL

(Continued from the October Issue.)

THE MONTREAL LIGHT, HEAT & POWER COMPANY.

The Montreal Light, Heat & Power Company's booth, with its multitude of winking and flashing lights and an endless array of novelties and special features in the way of modern application of electricity to the purposes of the household, was one of the most popular rendezvous for the crowds at the evening sessions throughout the Show.

CANADIAN ELECTRICAL EXHIBITION. EXHIBIT OF THE MONTREAL LIGHT, HEAT & POWER COMPANY.

There were too many elements in the exhibit of the company to enumerate in detail, but amongst these were noticeable a long line of electrical cooking appliances, such as coffee percolators, chafing dishes, water urns, grids, electrical sad irons, radiators, cigar lighters, etc. The Vacuum cleaner, with its 5 h.p. motor attached, was shown in full operation. This device, which cleans by a suction of air through a tube and thence through an attachment, and which may be run over a carpet or the pictures on the wall, or in fact any place where dust gathers, leaves the surface over which it passes as clean as though the substance were new. The machines are made in large or small sizes and are adaptable to either the purposes of a small residence or that of the largest hotel, the cost of the operation ranging up to 15 cents per hour.

Other features of the company's exhibit were the electrical adding machine, which, while consuming about the same power as an ordinary incandescent lamp, entirely eliminates all manual labor which accompanies the oper-

ation of the ordinary adding machine; the electrical addressograph which, similarly consuming comparatively little current, enables the operator to address about 5,000 envelopes per hour as compared with 2,000 or 3,000 when operated in the ordinary way; the electrical cloth cutter, which found no trouble in cutting through a solid 4 inch block of heavy cloth goods; electrical soldering and branding tools, water bottle heaters, curling iron heaters, kettles, the electrical coffee grinder, which disposed of four pounds of coffee beans per minute, the electrical meat slicer, which could be adjusted to make anywhere from 1 to 60 slices per minute from the thickness of a sheet of paper to three-eighths of an inch; the electrical meat grinder, turning out 5 or 6 pounds of Hamburg per minute, electrical vibrating appliances for curing headaches and other affectations, and the electrical washing machine, automatically washing and ringing a tubfull of linen every ten minutes.

Still another feature of the display was the extensive use made by the company of cable of the Elblight style, which lends itself particularly to decorative lighting. This cable is of such a composition that the lamps, which are equipped with two sharp prongs, may be stuck into the cable at any point and lighted.

In addition to these, the company had a very elaborate display of "free" electric signs. These signs were mostly from the company's regular stock and ranged from the ordinary steel panel sign to the large channel letter sign weighing from 700 to 800 pounds. The company has inaugurated an extensive sign campaign, and it is pertinent to note that it advocates the use of such general inscriptions as "Dry Goods," "Restaurant," "Cigars," "Quick Lunch," "Hotel," "Boots & Shoes," "Gents' Furnishings," "Florist," etc. Practically all of these signs were equipped with automatic motorless flashers. Upwards of 1,000 lamps were installed in these signs and elsewhere on the company's booth.

CANADIAN ELECTRICAL EXHIBITION—EXHIBIT OF THE CANADA ELECTRIC COMPANY.

Perhaps the best drawing cards on the company's booth were the family of winking "Indians," "Yellow Dogs," and "Owls." Each of these devices was equipped with a skedoodle lamp, which produced a perfect wink causing no end of comment, especially from the ladies and children. The exhibit covered nearly 1,000 square feet of space and was in charge of the company's commercial agent, Mr. J. J. Cagney.

ROBB ENGINEERING COMPANY.

The Robb Engineering Company's booth at the Electrical Exhibition attracted a great deal of attention, it being the only large steam engine exhibit at the Show.

One or two of the principal exhibits consisted of the following:

CANADIAN ELECTRICAL EXHIBITION—EXHIBIT OF THE ROBB ENGINEERING COMPANY.

One of their standard 12 x 12 Robb-Armstrong automatic side crank engines, direct connected to a 50 kw. generator, which is to be used as an exciter unit in connection with the fourth 1,000 h.p. cross compound Corliss engine direct connected to an alternating generator being installed at the Canadian Pacific Railway Company's Angus shops. This unit attracted considerable attention on account of the small space required, being only 9 feet square; also

One of their standard Robb-Armstrong vertical single crank high speed engines, which they manufacture in various sizes. The engine is of the enclosed self-oiling type, and especially arranged for direct connecting to generators, fans and centrifugal pumps, as well as for belted operation.

They also showed a working model of the Robb-Armstrong Corliss valve gear, which was especially interesting to engineers, it being a positive driven motion, requiring no latches, springs or delicate parts such as are used in the old type Corliss valve, while at the same time a motion is obtained precisely the same as that invented by Geo. H. Corliss. An engine fitted with this valve gear can be run from 75 to 175 revolutions per minute.

The exhibit was in charge of Mr. Alister Maclean, resident engineer of the Robb Engineering Company, Montreal.

NORTHERN ELECTRIC & MANUFACTURING COMPANY.

The Northern Electric & Manufacturing Company, of Montreal and Winnipeg, exhibited a complete line of their Magneto and Common Battery type telephones and switchboards. An interesting feature was the private branch exchange board of the latest type, being connected with the different types of Common Battery telephones, showing a complete working of a small exchange.

This company manufactures a complete line of fire alarm apparatus, and showed the different types of fire alarm boxes in use in the largest cities and towns throughout Canada, as well as a complete set of central office equipment, including gongs and indicators, which attracted considerable attention during the Exhibition.

A complete line of Conduit Oil Circuit Breakers, both in direct and alternating current, were shown, this company being the agents for this type of breaker in Canada.

An interesting machine to all persons having to keep record of men's time on shop work was the Calculagraph, which this company manufacture. This machine shows the elapsed time taken to do any work, simply by pressing handles which print the time when the work was started, and then on finishing shows the exact time taken to do the work.

A. Roy Macdonald.

The mica exhibit, by the A. Roy Macdonald Company, of Montreal, was very extensive and instructive, illustrating many new ideas for the use of mica. The display consisted of raw mica of all kinds and colors, manufactured in sheets of 2 inches x 3 feet. Samples were shown in various shapes, angles, tubes, rings, washers, discs, etc., and ground to many sized meshes.

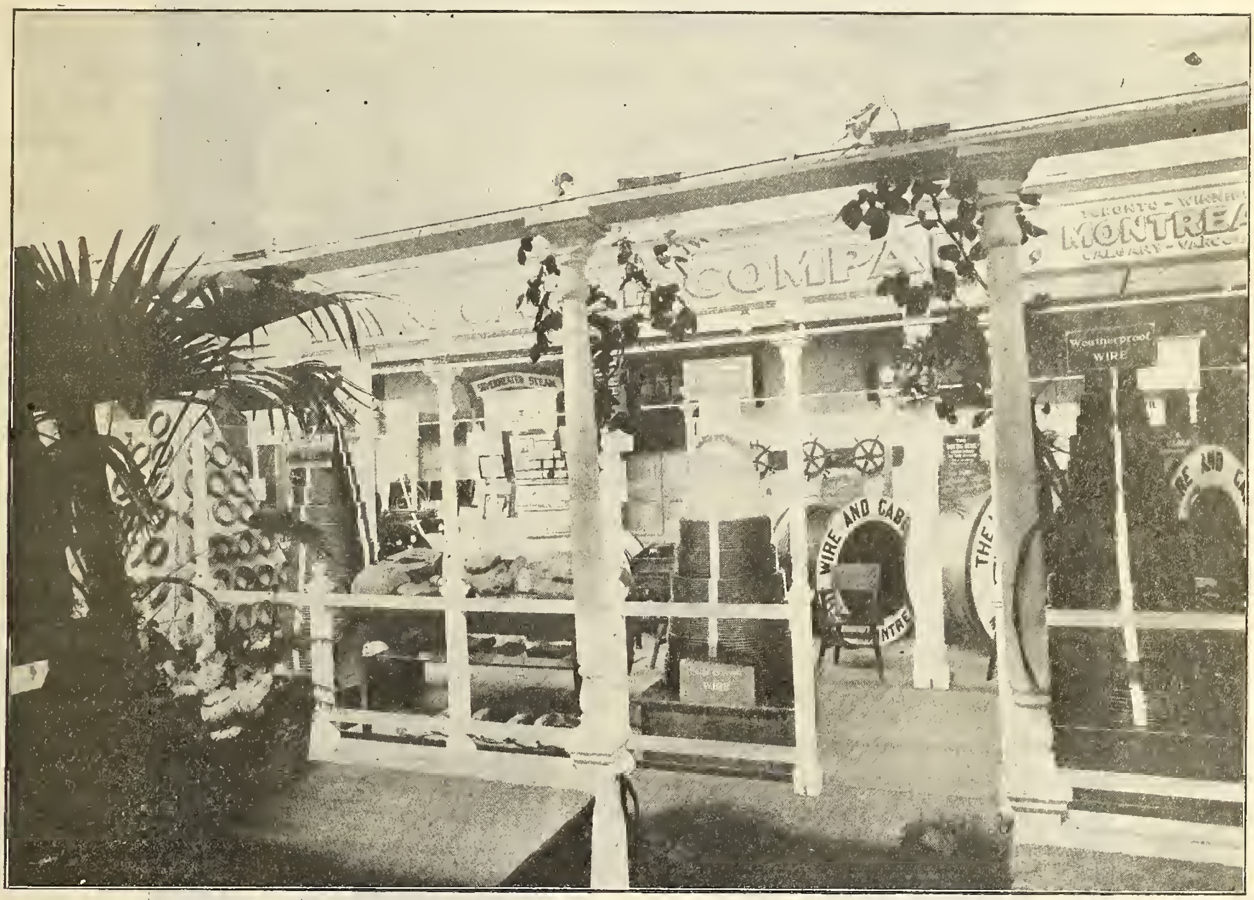
A section of a tube 10 feet long by 2 feet diameter, 1 1-2 inches thick, made of solid mica, and weighing over 1,000 pounds, was a very fine piece of work.

Fibre Conduit Company.

One of the exhibits that was of especial interest, particularly to the public service corporations and consequently their patrons, was the display of the Fibre Conduit Company of Orangeburg, N.Y. It consisted of a small but comprehensive line of conduits made of wood pulp, indulated, rendering it impervious to water, of high insulation, for all underground work, whether of high or low voltage. The process of homogenous or integral construction has placed the product of this company in a distinctive class and the conduits, which are five feet long each of various diameters, are turned out with socket, sleeve and screw joints as requirements may demand. The lightness of this material, together with its durability and other good features mentioned, certainly commanded attention.

We understand their latest production is an eighth inch wall sleeve joint, which on account of its cost may revolutionize to an extent underground conduit construction.

The exhibit was in charge of Mr. W. K. Sparrow, sales manager of the company, and his assistant, Mr. J. M. Nelson, jr.



Canadian Electrical Exhibition—Exhibit of the Wire & Cable Company.

The Wire and Cable Company.

The Wire & Cable Company had a most unique and instructive booth, where they showed the manufacture of the cable insulation by a machine that would be puzzling to any but a skilled operator. The copper cable is passed in at the base of a huge machine, where rapidly revolving balls of special cord weave about it three layers of covering. The operation is done with amazing dexterity, the cable that went in at the base as pure copper wire emerging from the top covered with waterproof insulation. There was also on view at the booth a table piled with a material that for the moment puzzled those who had never seen pure rubber "biscuits" before. The cakes of rubber were shown just as they left the districts where the material is gathered by the natives. Be-

fore the rubber goes into commercial use it is considerably adulterated and added to by materials that make insulation equally effective for ordinary purposes as if the pure gum was used.

Belliss & Morcom

Messrs. Bellis & Morcom, of Birmingham, England, the builders of the well-known "Belliss" engine, had an exhibit in charge of their Canadian representatives, Messrs. Laurie & Lamb, 212 Board of Trade Building, Montreal. They showed a fine selection of photographs, one large one of a 1,500 h.p. triple expansion Belliss engine in the Leeds City electricity station. Other photographs shown were of their Canadian installations.

The success of the Belliss engine has been wonderful, as shown by the fact that during the last fifteen years 3300 engines of this type have been built aggregating over 600,000 horse power. Out of 279 steam driven electric lighting stations in England, the cost records of which were given in the "Electrical Times" of 28th March, 1907, 151 were using Belliss engines.

Messrs. Laurie & Lamb also showed a sample of the Foster superheater, which is largely used in the United States and also in Canada, a recent Canadian order being from the Dominion Iron & Steel Company for 7,500 h.p. for installation in 30 B. & W. and Cahall type boilers.

Canadian Electrical Exhibition—Exhibit of Belliss & Morcom.

Northern Aluminum Company.

The Northern Aluminum Company, of Shawinigan Falls, had a very attractive exhibit of their various products, including aluminum wire and cable for electrical conductors, fuse wire, bus bars, and various mechanical joints. An interesting feature of the exhibit was a sample of the 61 strand 500,000 c.m. cable used by the Canadian Niagara Power Company for their crossing over the Niagara river from Fort Erie to Buffalo, the longest span being about two thousand and fifty feet.

On account of the great demand for aluminum this company have found it necessary to greatly increase their capacity, and they are now in a position to meet fully the demand for this particular product. The exhibit was under the charge of Messrs. Stanley and Hamilton.

THE PRESENT STATUS OF THE CARBON AND METALLIC FILAMENT INCANDESCENT LAMPS*

By J. M. Robertson.

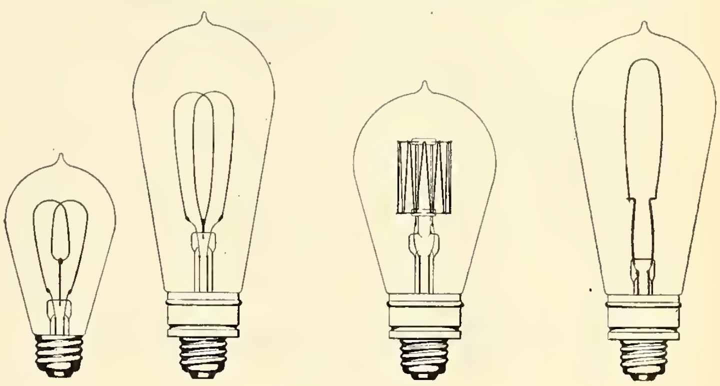
Through all the revolutionary changes that have taken place in electric lighting methods and apparatus during the past fifteen years, the only piece of apparatus that has retained practically unchanged its original form and characteristics is the carbon filament incandescent lamp. Although manufacturers and engineers throughout all this period were devoting a great deal of time and attention to the improvement of this most important factor in the lighting business, it could not be truthfully said that, previous to the last two or three years, any radical improvement had been made in the lamp, or that any definite prediction could be made as to the line of future development or as to the end which such development might ultimately reach.

It has long been recognized that an efficiency of from 3.5 to 3.1 watts per candle, as obtained from the carbon lamp, was much too low a figure with which to be satisfied, and that it was absolutely essential to the welfare of the electric lighting industry that there should be discovered some more efficient means of converting heat into light.

In the attempt to meet the demand for such improved lamps a number of systems of so-called high efficiency lamps made their appearance, in which the high efficiency was obtained by operating an ordinary carbon filament of relatively short and stout form at a much higher temperature than had previously been found satisfactory. These efforts were soon recognized as not being directed along correct lines, and the systems were never developed beyond the experimental stage.

High efficiency in incandescent lamps is directly dependent upon high operating temperature of the filament, and comparatively little improvement can be made in the efficiency of any given filament without increasing the operating temperature. The impossibility of further materially increasing the temperature of the ordinary carbon filament directed the attention of engineers to the possibility of using, as bases for filaments, other and more refractory materials which would withstand this increased temperature. These investigations, which have been proceeding for a number of years, have resulted in the production of a number of metallic filament lamps which, though far from perfect, exhibit such promising characteristics that for some time past all the large manufacturing companies have been engaged in endeavoring to commercially perfect a lamp having for its filament one or other of the rare metals. The development along this line, at this time, has not progressed to such a point as to indicate precisely what may be expected from this form of lamp as a perfected product, but it has reached the point where the manufacturers have been enabled to place on the market lamps which, on account of their serious limitations, may perhaps not be of permanent form or universal application, but show very much improved performance under conditions to which they are adapted when compared to anything which has heretofore been offered to the lighting industry. It is the purpose of this paper to present to the members of the Association a short description of some of the types which are at present on the market, giving an outline of their characteristics and limitations, and comparing them as comparative newcomers in the electrical field, with the older and more familiar carbon lamp.

The production of the carbon filament lamp has become so standardized and the problems connected with the treatment of the component parts have been so thoroughly investigated that the production of this lamp has become a more or less exact process, in which there remains practically no room for serious improvement. As most of you are aware, the filament of the carbon lamp is at present made of cellulose, obtained by treating cotton fibre. The filament formed by squirting this solution through a die is carbonized and subsequently treated in hydro-carbon gas in order to improve its quality and uniformity. The resulting filament is tough and elastic and lends itself readily to the further manipulation that is necessary in finishing the lamp. The weakness of the carbon filament, however, lies in the fact that its operating temperature must be comparatively low, not more than about 1800 degrees F., otherwise the life of the lamp will be short and its efficiency low, due to discoloration of the bulb. The best commercial efficiency which this lamp has attained has been 3.1 watts per candle, but by far the larger part of the lighting business is being done with lamps which consume 3.5 watts per candle or worse. Aside from the low efficiency, the carbon lamp has other objections. It must be operated at practically constant voltage in order to avoid large fluctuations in the candle power, and any considerable increase in voltage results in a very considerable shortening of the life.



A B Fig. 1 C D

6 C. P. Carbon. | 40 C. P. Metallized. | 40 C. P. Tantalum. | 40 C. P. Tungsten.

The Metallized Filament lamp is the result of an effort

* Paper read at the Annual Convention of the Canadian Electrical Association.

to produce a carbon filament which could be operated at a higher temperature than has been found possible with the ordinary form of filament. Its manufacture follows precisely the line of the ordinary carbon filament to the point of carbonization, after which, instead of the hydrocarbon treatment at low temperature, the filament is subjected to a temperature of about 3500 degrees C. in an electric furnace. This high temperature treatment changes the structure of the carbon, which becomes much more completely graphitized than is the case with the carbon filament. Incidentally this treatment also drives off all impurities in the carbon and as a result there is an almost complete elimination of the blackening of the

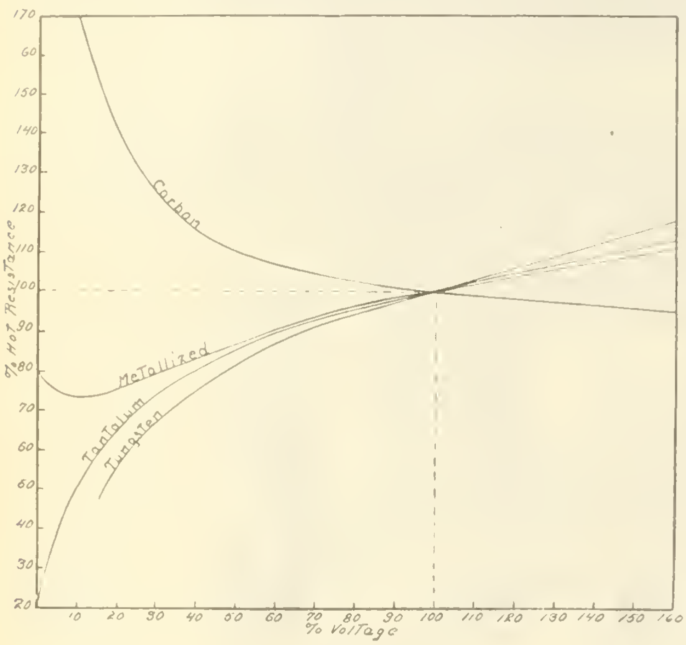


FIG. 2.

bulb of the lamp after it has been in use for some time. This treatment also fundamentally changes the electrical characteristics of the filament, for whereas a carbon filament has a negative temperature co-efficient, or in other words its resistance decreases with increase in temperature, the re-treated filament has a positive temperature co-efficient, or its resistance increases with increase in temperature. In this respect it resembles the metals whose temperature co-efficients are all positive, and on account of this resemblance the name "Metallized" was bestowed upon it. This characteristic is very clearly shown in Fig. 2, in which are given the curves of resistance of the Carbon, Metallized, Tantalum and Tungsten filaments. The general similarity of the last three curves and their entire dissimilarity to the first, will be readily noted. This peculiarity has more than academic interest, inasmuch as it is the cause of a very considerable improvement in the light regulation of the lamp, when operated on a fluctuating voltage, since the increasing current, due to an increasing voltage, causes an inerease in the temperature of the filament, raising its resistance and automatically checking the current. As a result the increase in the candle power of this lamp is only about 80 per cent. of the increase which would take place in a carbon lamp under the same increase in voltage.

In general design the lamp follows closely the lines of the carbon lamp, which may be seen by a glance at Fig. 1. in which B represents a metallized filament lamp of 40 candle power and A is an ordinary 16 candle power carbon lamp, drawn to the same scale. It will be noted that the metallized filament is in two plain loops instead of the familiar oval. This modification was necessitated by the very considerable shrinkage that takes place during the treatment, and which would cause abnormally large loss through breakage during treatment if the filament were not free to move on the form. The lower specific resistance of the body of the filament requires the use of a filament of smaller section or greater length in order to obtain the same resistance as a carbon filament. This requires the use of more than one filament for lamps designed for standard voltages. The filament, on account of the reduced diameter, as well as on account of the increased brittleness of the material, is more fragile than the carbon filament, and consequently metallized lamps require greater care in packing and handling than the carbon type. The lamp is also not so well adapted to operation in places where there is a great vibration, or where it might be exposed to shocks. These lamps may be obtained in a range of candle powers from 20 to 100, suitable for all voltages from 100 to 130.

The best efficiency of the Metallized filament lamp is about 2.5 watts per candle, and the life of the average lamp under good conditions of regulation is about 560 hours.

Since the first appearance of the Tantalum lamp about three or four years ago, a great deal of attention has been devoted to the development of the lamp in order that it might be placed on the market with some assurance as to its performance in the hands of the operating companies. In general appearance the lamp is somewhat different from the usual carbon lamp, as will be seen by reference to Fig. 1 C, which shows the present type of

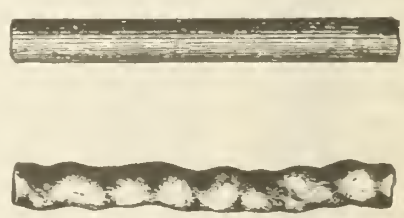


FIG. 3.—TANTALUM FILAMENT BEFORE AND AFTER USE.

lamp on the same scale as the carbon lamp. The arrangement of the filament and the supporting spiders may also be observed.

In a general way the process of manufacture is very similar to that of the carbon lamp, the main point of difference being that the filament is formed of a piece of tantalum wire. This wire is drawn at a high temperature in an atmosphere free from oxygen. It is then stretched loosely over the supports, which are formed of copper wire sealed into the glass of the stem, the ends being connected to the leading-in wires as usual. The comparatively low specific resistance of the metal necessitates the use of a very long filament, even though it be

of very small diameter, as much as 27 inches being used in the 20 candle power lamp of one maker. The filament, though quite loose in a new lamp, rapidly tightens, due to the contraction of the metal as the use of the lamp proceeds. Continued use of the lamp causes a change in the form of the filament which, when new, was like an ordinary piece of wire in appearance. This change appears to be a sort of disintegration of the metal in which

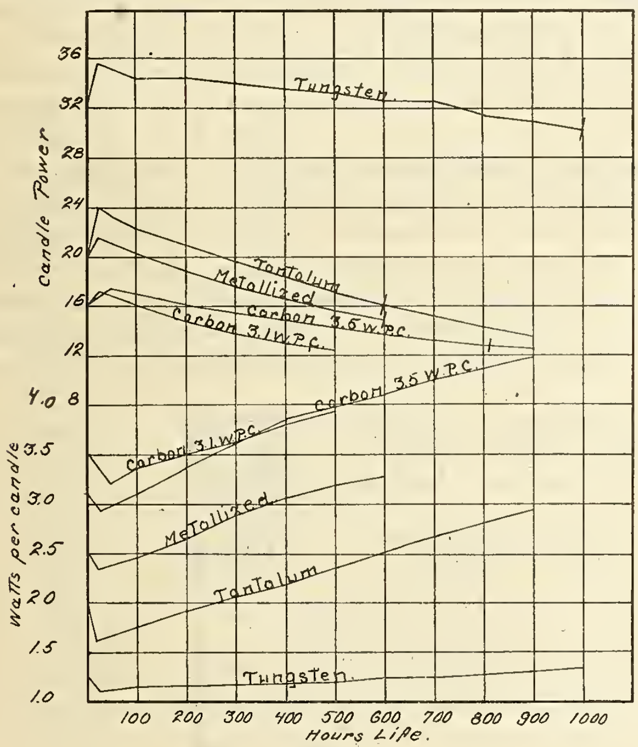


Fig. 5.

parts of the filament become displaced with respect to each other. This disintegration proceeds continuously until the filament eventually breaks. The appearance of a new and a used filament is well shown in Fig. 3, in which is very apparent the roughening of the wire. As a rule the first few breaks in the filament do not terminate the life of the lamp, as the filament has the faculty of instantly welding together if the parts be brought in contact by jarring or otherwise. This usually results in the cutting out of a part of the filament and the consequent lowering of the effective resistance of the lamp, the result being a higher operating temperature of the remainder of the filament and a more rapid reduction in its life. As a rule the first break in the filament of a lamp whose total life would be about 600 hours would occur after about 300 to 400 hours. On account of the great length of filament required to obtain the necessary resistance, it has heretofore been impossible to make lamps of very high voltage or very low candle power. At present lamps are obtainable in 20 and 40 candle power units at voltages between 100 and 130 volts. Low voltage miniature lamps may also be obtained for use on battery circuits and in other places where high efficiency is especially desirable, and as the efficiency of these lamps is about double that of the carbon lamp they offer very considerable advantages. There is a possibility that lamps of about 10 to 16 candle power at 110 volts, having an efficiency of about 2 1-4 to 2 1-2 watts per candle and a life of about 500 to 1,000 hours, may soon be obtainable. Such a lamp would actively compete with the carbon lamp for domestic and business lighting. At present the best efficiency of the larger units is about 2 watts per candle, with a life of about 800 to 900 hours on well regulated circuits. Until recently the Tantalum lamp was not recommended for use on other than direct current circuits, but the lamp has been improved to such a point that it may be used on alternating current at the same efficiency as on direct current, though with a reduced life. Under ordinary conditions and on 60 cycles the life should average about 60 per cent. of the life on direct current under the same conditions. This reduction in life is due to an increase in the rate of disintegration of the filament and increases with the frequency of the alternations. The lower the frequency the nearer the results approach direct current figures.

The lamp may be installed in any position, and no special care is necessary in handling, as it will withstand ordinary rough usage and vibration without difficulty.

The latest production to be placed on the market in the line of high efficiency lamps has been the Tungsten lamp. This lamp, while of the metallic filament class, and similar in some respects to the Tantalum, differs from it in a number of important particulars. The filament, though metallic, is not formed from a piece of wire, but is the result of a chemical process carried on in one or other of two general ways. Either the filament is formed of a sale of tungsten incorporated with a binding material into a paste, which is then squirted through a

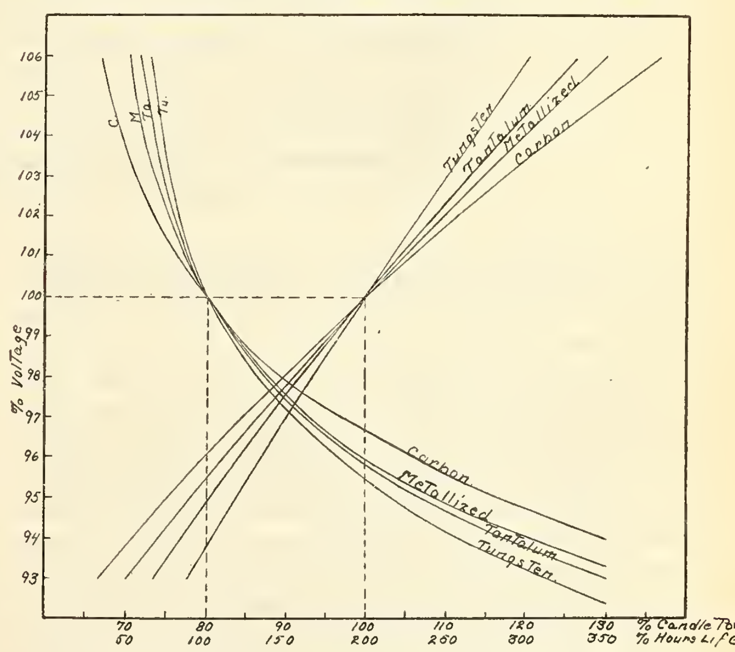


Fig. 6.

die, the filament being subsequently treated in order to reduce the metallic tungsten on the filament and eliminate the binding material, or the original filament may have no tungsten whatever in its composition, being formed of material designed to be replaced entirely by the metallic tungsten during treatment.

In form the Tungsten lamps at present on the market

follow very closely the lines of the familiar carbon lamp, as is evident from Fig. 1 D, which represents a 40 candle power lamp. The manufacturing difficulties which make the production of the Tantalum lamp a somewhat difficult proposition are much magnified in the case of the Tungsten lamp. To the difficulties of handling long and slender filaments must be added the troubles due to extreme brittleness when cold. This quality of brittleness has heretofore made the Tungsten lamp a somewhat uncertain quantity, as the filament was liable to break on the slightest provocation, and even now, after the filament has been considerable strengthened, it still requires the most careful handling to avoid breakage. For this reason this lamp is not suitable for use in locations where it would be subject to vibration of any kind. The fact that owing to the tendency of the filament to drop, the lamp can only be installed in a vertical position, also limits its usefulness to a great extent. In fact, its usefulness at present seems to be confined entirely to street lighting, where the conditions most nearly suit its peculiar properties. The efficiency of the lamp in units of 40 to 60 candle power suited to this work is about 1 1-3 watts per candle, and the life on well regulated circuits is about 1,000 hours.

Having thus indicated in a general way the most prominent characteristics and limitations of these various lamps, I would draw your attention to Figs. 5, 6 and 7, in which I have drawn comparisons between the results which may be obtained from the perfected carbon lamp and the higher efficiency types. In Fig. 5, which shows the variation of candle power and watts per candle as the life of the lamp proceeds, you will note that the newer lamps show much better maintenance of initial candle power than does the carbon lamp. In fact, in the case of the metallic filament lamps the useful life terminates at the burning out point, not at a much earlier stage, as in the case of the carbon lamp. This peculiarity will be of greater benefit when lamps of this type are in common use for interior illumination, as there will be no necessity to persuade customers to have dim lamps changed, since there will be no intermediate point between a perfectly good lamp and a burnt out one. It should be noted that the areas enclosed beneath the watts per candle curves in Fig. 5 represent the energy consumption of each lamp for the same quantity of light and indicate clearly the advantages to be gained by the use of high efficiency lamps. Fig. 6 shows what may be expected from these lamps when they are subjected to abnormal conditions. The set of curves running downward from left to right indicate the increase or reduction in life corresponding to a lower or a higher voltage than normal, and the curves running upward from left to right show the increase or decrease of candle power with increase or decrease in voltage. It will be observed that the metallic filament lamps again demonstrate their superiority under these conditions. In low increase in candle power with increase in voltage as well as in ability to withstand considerable increase in voltage without material reduction in life, they easily lead the older lamp. Of course, it is understood that such increases in voltage do injure any of the lamps more or less, and the best performance in service cannot be expected except under good conditions.

Kind of Lamp	Candle Power	Amperes	W. P. C.	Total Watts	Hours Life	K. W. Hours consumed during life.	Cost of Lamp.	Cost of Renewals per 1000 hours.	COST OF POWER PER K. W. HR. 1c	2c	3c	4c	5c	6 c	7c	8c	9c	10c	For each 1c difference in cost of Lamp add or subtract value below.	Cost of Renewals per 1000 Watt hours.
									Combined Cost of Power and Lamp Renewals per 1000 Hours.											
Carbon Street Series	30	7.5	3.5	105	410	43	$0.75	$1.83	$2.88	$3.93	$4.98	$6.03	$7.08	$8.13	$9.18	$10.23	$11.28	$12.33	$.024	c1.744
Carbon Street Series	40	7.5	3.5	140	410	57	.80	1.95	3.35	4.75	7.15	8 55	9.95	11.35	12.75	13.15	14.55	15.95	.024	1.403
Tungsten Street Series	40	7.5	1.35	54	1000	54	2.00	2.00	2.54	3 08	3.62	4.16	4.70	5.24	5.78	6.32	6.86	7.40	.010	3.704
Carbon Street Series	60	7.5	3.5	210	410	86	.80	1.95	4.05	6.15	8.25	10.35	12 45	14.55	16.65	18.75	20 85	22.95	.024	.930
Tungsten Street Series	60	7 5	1.35	81	1000	81	2.00	2.00	2.81	3.62	4.43	5 24	6.05	6.86	7.67	8.48	9 29	10.10	.010	2.469
Metallized Multiple	40		2.5	100	575	58	.45	.78	1.78	2.78	3.78	4.78	5.78	6.78	7.78	8.78	9.78	10.78	.017	.776
Tantalum Multiple	40		2.0	80	900	72	.95	1.05	1.85	2.65	3.45	4.25	5.05	5.85	6.65	7.45	8.25	9.05	.011	1.319

FIG. 7.—Cost of Operation of Series Street Lamps on Alternating Current Circuits.

In Fig. 7 I have shown in tabular form the relative costs of operating series street lighting systems with carbon lamps, such as are in use almost everywhere at present, and high efficiency Tungsten lamps, from which it will be observed that, notwithstanding the relatively high price of the new lamp, they are cheaper in the end at any price for power that is applicable to the business. The saving increases, as might be expected, with the increase in the cost of power, until at 10 cents per kw. hour the total cost is only one-half that of the carbon lamp. For the sake of comparison I have added two lines which indicate what might be expected from the Metallized and Tantalum lamps of the same capacity. It will be noted that at 1 cent per kw. hour the carbon lamp cannot compete with the Metallized filament, which in turn must yield to the Tantalum at 2 cents, and it in turn to the Tungsten at 4 cents.

In addition to these lamps there are one or two other sizes which can at present be obtained in limited quan-

(Concluded on Page 28)

The Value of the Nernst Lamp to Central Stations*

By A. E. Fleming.

Probably no other piece of apparatus made so little change or improvement as did the incandescent lamp, until about four years ago, when a watt per candle was hailed as a great improvement. Within the last three or four years more new types of lamps have been brought out than at any time during the thirty years' existence of the incandescent lamp. With the introduction of these new types has come a remarkable change in the sales policy of central stations. The most progressive have not only taken advantage of high efficiency lamps, but also have become more liberal and broad-minded in their dealings with the consumer.

We now have to consider the tungsten, tantalum, the metalized filament, and among the arc lamps, the luminous and the flaming metallic arc. The Cooper Hewitt and the Moore tube must also receive attention.

It is interesting to note the change which has come over the papers presented to the National Electric Light Association since the Convention held at Denver, Col., in 1905. Previous to this Convention the topics most generally discussed were saving of small losses in generating and secondary distribution. Now, however, the papers presented deal with "How can we best sell our current?" This subject has brought out new ideas with regard to making rates, systems of renewal, methods of advertising and securing new business, co-operation between the central stations, manufacturers, contractors, architects, engineers and consumers. It has also developed a demand for the services of competent illuminating engineers in the employ of central stations.

The question of the value of a high efficiency lamp has been thoroughly discussed, and from actual practice there is no question with regard to the benefits derived. If this is not the case, why should not manufacturing companies be receiving a demand from the central station for four and five watt lamps instead of a demand for increased efficiency? The central stations now realize that they must be more enterprising than heretofore, and give the consumer the benefit of improved service, which includes the most efficient lamp that can be procured.

We need no better example of the effect of supplying consumers with increased light for the same money than the experience of gas companies with the introduction of the Welsbach mantel.

Of all the high efficiency lamps now on the market none have been submitted to more severe and rugged tests than the Nernst lamp has received.

It had passed the experimental stage some years ago, and today is as much of a commercial proposition as the enclosed arc lamp or the three and one-tenth watt incandescent. It is now a standard piece of apparatus, and with some central stations represents their standard lamp of high candle power, they no longer furnishing arc lamps or a high candle power incandescent.

The Nernst lamp is, as most of you are aware, the salvation of electric light companies in meeting gas and gasolene competition. It has enabled the central station manager not only to retain dissatisfied customers, but also secure new business from competing gas companies. This is verified by the report of the Committee on Progress of the National Electric Light Association, presented by Mr. T. C. Martin, before the Convention in 1906, which is in part as follows: "It appears to be the general experience that one three-glower Nernst lamp taking 264 watts is able in commercial practice to replace the ordinary four-burner gas 'arc' lamp; and this is confirmed by some recent tests, which show that the useful light from a three-glower Nernst is about the same as that from a four-burner gas 'arc.' Assuming the Nernst lamp to be supplied with electrical energy at ten cents per kilowatt hour, the cost of operating the three-glower 264 watt Nernst lamp would be 2.6 cents per hour. Four-burner gas lamps, when burning at an efficiency making them comparable with three-glower Nernst lamps, consume in the neighborhood of 20 cubic feet of gas per hour, making a cost of 2.5 cents per lamp hour, with gas at $1.25 per thousand cubic feet. With the cost to the user approximately the same, the electric light naturally has always the preference."

An example of what can be done is illustrated by the experience of the Yonkers (N.Y.) Electric Light & Power Company, which is also mentioned in Mr. Martin's report, above referred to, as follows: "The first Nernst lamp installed by the company was in January, 1903, and one of the most notable instances of its successful employment to win over the shopkeepers of a small city to the cause of electric lighting has been at Yonkers. Gas there sells at $1 per thousand cubic feet, but so successfully has the electric company pushed the Nernst lamp that gas and gasoline arc lamps have almost entirely disappeared. Many shops, although still equipped with ordinary Welsbach mantel gas lamps and gas arc lamps, use the Nernst lamps in preference. The company supplies the Nernst lamp free of charge and looks after its maintenance, with the result that the business has grown enormously. On June 1, 1905, the number of Nernst lamps installed was as follows: 196 one-glower lamps, 382 three-glower lamps, and 13 six-glower lamps—a total of 591 lamps, with 1,420 glowers. The growth since then may be gauged from the number in use on March 1 of this year, which is as follows: 638 one-glower lamps, 571 three-glower lamps, and 10 six-glower lamps—a total of 1,219 lamps, with 2,411 glowers, making an increase of over 100 per cent. in the number of lamps connected in nine months."

The Nernst system consists of five units for use on alternating current circuits of 110 or 220 volts, 25 to 133 cycles, for indoor and outdoor service, which are classified as follows:—

The one-glower lamp, consuming 88 watts at 220 volts, will replace three 16 c. p. incandescent lamps, or one gas mantel.

The two-glower lamp, consuming 176 watts at 220 volts, will replace seven 16 c. p. incandescent lamps.

The three-glower lamp, consuming 264 watts at 220 volts, will replace ten 16 c. p. incandescent lamps, or one four-burner gas arc.

The four-glower lamp, consuming 352 watts at 220 volts, will replace fourteen 16 c. p. incandescent lamps, or one 6 ampere a. c. enclosed arc lamp.

The six-glower lamp, consuming 528 watts at 220 volts, will replace twenty 16 c. p. incandescent lamps, or one 7 1-2 ampere a. c. arc lamp, or one 5 1-2 ampere d. c. arc lamp.

The two and three-glower lamps place in the hands of the central station two units for which there has been a demand for a number of years, that is, a lamp which would come between the arc lamp and a high candle power incandescent lamp.

A very important advantage of the Nernst system not possessed by any other is that the five units are all of the same color value, thus enabling us to get away from the detrimental effect of operating arc and incandescent lamps in the same interior. This feature was one of the strongest points which led to the adoption of the Nernst lamp for the lighting of the large Pennsylvania depot and terminals in New York City. The illuminating engineers in charge of this work had one of the most difficult propositions to consider that has ever come before the lighting world. From the lighting of the main waiting room, which is approximately three hundred feet long, one hundred feet wide, one hundred and sixty-seven feet high, down to a small office of sixteen by twenty feet, with a ceiling twelve

*Paper read at the Annual Convention of the Canadian Electrical Association.

feet high, was the task which confronted the engineers, and after careful consideration and exhaustive tests it was decided to use approximately fifteen thousand Nernst glowers.

That the Nernst lamp gives the proper light for stores hardly needs any further recommendation than the fact that it has been adopted by Marshall Field & Company, of Chicago, for the lighting of their thirty-eight acres of floor space, replacing forty thousand incandescent lamps and necessary fixtures by approximately twelve thousand glower units.

The objection of high initial cost of the Nernst system is often raised by engineers not thoroughly conversant with the subject. They do not stop to consider the low power factor of the arc lamp, which necessitates additional outlay in secondary distribution, transformers and station equipment. This additional cost should be charged in all justice to the arc lamp equipment, or we must open a new account, to which can be charged the additional investment in apparatus. If it is placed, where it properly belongs, against the arc lamp, you will find that the Nernst lamp costs very nearly fifty per cent. less per unit.

Another objection which we often hear against the Nernst is the high cost of maintenance, and that it necessitates "expert" labor to maintain it. If a man who trims and looks after arc lamps can be considered an expert this statement is true, though it is not generally conceded that such labor is considered high class or expert, but more properly comes under "experienced." There is nothing new about the general system employed in taking care of Nernst lamps; it has long been in vogue with the large central stations in handling their arc lamps. At the prevailing guarantees and prices on Nernst lamp repair parts in Canada, they can be maintained for six-tenths of a cent per kilowatt hour, though some central stations, which are now using the largest number of lamps, claim that they are maintaining them for three-tenths of a cent per kilowatt.

That the Nernst lamp is making rapid advancement in Canada is proved beyond a doubt by the fact that in less than two years over twenty thousand glowers have been installed. In the United States there are now in operation over one million glower units.

In marketing the Nernst lamp several methods are open to the manufacturer, through the jobber, supply dealer, contractor, through the central station, or directly to the consumer. The channel chosen was through the central station, as the manufacturer believed this was the best way to reach the consumer.

Some of the advantages of the Nernst system to the central station are as follows:

In aiding the central station to change their flat rate to meter rate contracts.

As an effectual means of meeting gas competition.

As a means of presenting something new to the prospective customer.

As a means of obtaining a larger volume of business which may be classed under the heading of "advertising," such as window display illumination, lighting of store fronts and special street lighting.

As a means of broadening the peak, due to the ability of the central station to obtain a large number of small contractors, who as a rule have a connected load very nearly equal to their daily peak consumption.

Another advantage lies in the fact that while central stations have been trying "to sell current at the meter," they now generally recognize the fact that they must go further and act as illuminating engineers, and accordingly become more interested in actually selling illumination.

There are now sixty central stations in Canada and seven hundred and fifty in the United States purchasing Nernst lamps under contract with the manufacturer.

Though the Nernst lamp is established as a thoroughly commercial proposition, improvement will go on, new types of lamps will be developed, and everything done to render the lamp a benefit to the central station. The latest lamps to be placed on the market are the single vertical glower series lamp for street lighting, and a 220 volts direct current lamp in one, two and three-glower sizes.

We cannot lay down any rule for the marketing of Nernst lamps which would apply in all localities. The demand for any article is based, first, upon its merit, and second, upon the publicity given the article and its advantages. There is no question about the advantage of the Nernst lamp to both the central station and the consumer. The manufacturer is desirous of co-operating with the central station in various methods and mediums of publicity, to create a demand for the Nernst lamp as an inducement for the use of current.

We sincerely request that central station managers adopt a policy of being in closer touch with their consumers, that they keep themselves in line with up-to-date methods of obtaining business, and that they educate their customers to the longer use of light. This also applies to the number of municipal plants in Canada. The consumer cannot be expected to study out the lighting proposition for himself, and it is the duty of the central stations to give the customer the benefit of their knowledge of all economical methods of lighting, and the sooner that this is done the sooner we will hear less about the grasping monopoly, the indifferent corporation, the arbitrary and independent electric light company.

DISCUSSION.

The President: This is a paper upon which I expect there will be considerable discussion, as we are all interested in Nernst lamps, or anything else which will increase the revenue of electric lighting companies. Mr. Dion, will you please open the discussion?

Mr. Dion: I would prefer to speak later.

The President: Mr. Fisk, will you please open the discussion?

Mr. Fisk: We have had some Nernst lamps on our circuit but did not have very good luck with them.

The President: What regulation have you, six, eight or ten per cent.?

Mr. Fisk: Just ordinary, I would not like to put it on a percentage basis.

The President: Mr. Welbourn, have you had any experience in Europe with these lamps?

Mr. Welbourn: No, I do not know much about this subject and prefer not to discuss it at present.

Mr. R. S. Kelsch: In connection with Mr. Fleming's paper I might say the Montreal Light, Heat & Power Company are completing a new office building at a cost of $200,000, which is to be lighted with the Nernst lamps. In reference to his remarks as to the central station manager acting as the illuminating engineer, I will say that at the Windsor Hotel about two months ago they installed Nernst lamps in the bar room, which is decorated at great cost, while the ceiling has a color similar to the walls of this room—green. The Nernst lamps remained in the room about 48 hours, and I understand that they took them out because everybody that came in failed to recognize their friends and buy them a cigar, so they took the lamps out. They gave a ghastly color to everything, and this was simply due to the fact that the illuminating engineer was not there when the lamps were installed. A man posted in the business would not instal the lamps with a ceiling of that kind or any other kind of lamp with a large globe and considerable light in a small space, and more especially with a ground glass globe.

Mr. Ryerson: I would like to ask how successful the Nernst lamp is on a 25 cycle circuit. That is the question with us, how to get something with a greater illuminative power than the ordinary incandescent lamp on a 25 cycle circuit.

Mr. Lansingh: On a 25 cycle circuit you can get about 400 hours, that is shortening the life of the parts very slightly, not appreciably.

Mr. Dion: I am interested in these lamps and in any other

lamps of moderate power and good color for interior illumination, whether small incandescent lamps or lamps of more than ordinary power, such as the sunburst lamps, etc. If you want anything larger than that I advocate a lamp like the Nernst rather than the arc lamp. I think the arc lamps have been used a great deal too much for interior illumination and without regard to their fitness. The arc is not suitable for interior illumination except for very large spaces, but some people are satisfied with anything that gives light, and the arcs have been used where the effect would have been much better if the light had been divided into more and smaller units. The Nernst lamps being very effective in that way, there is a very extensive field for their use in places where arcs are now used.

The question of renewal was touched upon, and prices given for renewals. I see it given as six-tenths of a cent and in some cases as little as three-tenths of a cent. I do not think we should figure renewal cost too closely, because we should not try to keep it too low; we should rather throw the glower out before it is actually burnt out, following the same policy as with incandescent lamps for good results, that is to renew the glowers when they have lost a certain percentage of their illuminating power without waiting for them to actually burn out. I think it would pay central station companies to be liberal with their renewals.

As to the central station manager acting as an illuminating engineer, I am convinced that we have to do it, and every central station company must do it in its own interest. We must suggest means of improvement to the people and not wait for them to find them out from others. I go so far as to say that we should suggest these things even when they lead to a saving in cost of illumination to the people and lead to a temporary small loss of revenue to the company. It is in the broader interests of the central stations to suggest to their customers the latest devices to make electric light better, more pleasant, economical and satisfactory.

I have a few notes here that I got from the man in our company who has charge of the Nernst lamps, and which he jotted down for me in a hurry. I would say with regard to renewals that we have used Nernst lamps so far only in stores and places of that kind on flat rates, and we are not in a position to say what the cost of renewals and maintenance generally would be per kilowatt hour in these flat rate commercial installations witn the consequent free use of the lamps. Some have them in show windows, burning all night, and in other stores I know of many lamps burning all day long. The consumption varies much, but it is very much in excess—I do not know just how much—of that under the meter system. Under these conditions we have found our maintenance to be from three to four cents a week per glower, averaging 3 1-2 cents. This covers everything, renewals, labor and inspection, also patrolling. Our man goes to find what the lamps need before the customers have to call for him, and this is all charged to maintenance.

We think, with depreciation tests by no means conclusive, that loss of illuminating power is say about 30 per cent. in 400 hours. Here is a note from the man in charge of the lamps. He says the life of the glower cannot always be depended upon. We have glowers running 700 hours and still giving a brilliant and satisfactory illumination, while others burnt out in a day. In some cases the glowers have broken, from what causes I do not know. There is also some trouble in ballasts. These, however, are replaced by the manufacturers free of charge. We have had a little trouble with the heaters, the heaters making about 10 per cent. of the total maintenance cost.

Our experience covers installations of six hundred and sixty-eight glowers, made up of 2, 3, 4 and 6 glower lamps. The two and three glower lamps are the most popular; there is not much demand for the larger units, and the smaller ones seem to run more satisfactorily. We have found the Nernst lamp very good for store window lighting when used with the proper reflector. The color is splendid for showing off goods.

We have made a little improvement in the manner of hanging the lamps in windows which has been helpful in making the lamp popular. We found that it was always difficult to go into a window to replace a glower, and it could only be done when the window was being dressed. We get over that by making a small hanging board where the lamps fit in, and then from a cord carried over small pulleys it is suspended so that it can be lowered. As soon as the tension is taken off the cord the lamp drops out of its place, breaking the electric connections, and it is then reglowered and pulled back into place without disturbing the contents of the window.

The President: Mr. Fleming has a lot of valuable information, both technical and commercial, in reference to these lamps, and you had better put him through a catechism, that is the best way to get information for the convention. The more questions you ask the more information you will get. It is said that when you go traveling you should take your wife with you, as she will ask the questions and save you the trouble. If you do not ask more questions we shall have to bring the ladies to the convention. (Laughter.)

Mr. L. Burran: What is the effect of vibration, in a factory, for instance, on the Nernst lamp and the glowers?

Mr. Fleming: No effect upon the ballast at all, but it might affect the glower and make it sag, which would prolong the operation of lighting. If you place the glower a sixteenth of an inch away from the heater it would take 30 seconds to light up, at an eighth of an inch away it would take a full minute and a half. So the vibration might create some trouble by causing the glower to sag, but that could be overcome by placing a spiral spring, costing a few cents, over each lamp, like the spring over a canary cage, which would take up the vibration and stop all trouble from vibration. I have seen telephones hung in the same way in factories where there is a great deal of vibration. We are running lamps in shops where there are heavy presses on the floor above and have experienced no trouble.

I would like to make a few remarks in connection with what Mr. Dion said about heater tube trouble. The trouble was no doubt experienced in two glower lamps which were permitted to run on one glower, thus allowing the heater tube to come into the circuit, shortening their life by giving them a continuous run, while they are only intended for a lighting up period of about thirty to forty-five seconds.

As to the depreciation in the candle power of the Nernst lamps the average depreciations as fixed by our tests and those of others is put at 20 per cent. during six hundred hours. With the Nernst lamp you have an easier proposition with regard to depreciation than with any other form of illuminant. Take the three glower lamp for example. You will run the lamp for about three hundred hours and the first glower burns out, you put in a new one and that brings the candle power up again. It is a question whether you speak of the depreciation of a lamp or a glower, and the matter of depreciation in these lamps must be met with this distinction; we of course speak of the depreciation of the lamp.

Mr. Dion: We had in our office two rooms divided by a partition with a door which was kept open. In the centre of one room we had a four glower Nernst lamp, and at the same distance and same height in the other room we had a 6 1-2 ampere alternating current enclosed arc lamp. The partition was exactly midway between, so that we could compare the relative values of the lights by the shadow of the partition and I watched it from day to day. I can say from that test that the Nernst lamp was the better. Of course the arc lamp would vary more, but taking it altogether the Nernst lamp was by a little bit the greater source of light. It was a four glower lamp.

The President: Mr. King, do you use any Nernst lamps in Stratford, and if not why not?

Mr. King: No, we do not use them there, Mr. Black.

The President: Why not?

Mr. King: I understand you cannot use them on a direct current.

The President: Well, there is a direct current Nernst lamp on the market now, perhaps Mr. Fleming will tell us about it.

Mr. Fleming: It is only within the past six or eight weeks that the direct current lamp has been placed on the market. The only difference between it and the ordinary lamp is in the glower, practically the only difference is in the positive terminal, which is made much heavier. There is a question as to whether the making of that terminal heavier was due to the electrical action or to excess heating at the positive end. The other parts of the lamp remain practically identical. The average life of the glower on direct current is 500 hours, and there is no question that within a short time the same glower will be used in the alternating lamp as in the direct.

Mr. V. R. Lansingh: I have a few questions I would like to ask Mr. Fleming along technical lines, and I will put them in order:—

1. I should like to know the watts per mean spherical candle power.

2. The watts per mean lower hemispherical candle power.

3. The relative efficiency of the different sizes. If you take for example the three glower as a standard size, what are the efficiencies of the one and two glowers, which will naturally be less, and the four and six glowers, which will naturally be higher?

4. What is the relative efficiency of the Nernst lamp on direct and alternating current circuits? That is, will the direct current lamp be as efficient as the alternating current lamp?

I should also like to call attention to the question of shadow tests, which are used very considerably and generally are in error. The shadow test is not correct unless both the sources of light are similar in size. If, for example, you take the arc light and moon light you will get a more intense shadow from the arc than from the moon, but no one would say that the total amount of light from the arc is equal to that from the moon, and the same thing is true in all forms of lights. Unless their sources are the same in size you cannot judge of their intensity. Take a Nernst lamp with a clear or very light globe and compare that with an arc with a large opal globe, or reverse the conditions. The one with the small intense light will cast the heavier shadow. Therefore it is not fair to make a comparison by the shadow test unless the sources are of the same size.

Another point I should like to bring up is relative to the care and attention the Nernst and arc lamps get. Both the Nernst and arc lights are regularly attended to by men going around to see that they are in good condition, and they are carefully inspected every so often. With the incandescent lamp we do just the opposite. We let it stay on our circuits until it is practically burnt out, or so black that it is of little use. Therefore if we are going to make comparisons of the Nernst and arc lamps with such a lamp as the incandescent we should give the same attention and care to the incandescent that we do to the others.

Another thing greatly in favor of the Nernst lamp is that its distribution is largely downward. With the incandescent, on the other hand, we get a distribution entirely different, the maximum being at the horizontal. In a room for instance like this, in a comparison between the two lamps, we would find the incandescent would suffer very materially. We are using these lamps here in the very worst possible position and should equip them with proper reflectors, the same as the Nernst is equipped with a small white porcelain above the glower. So to make a fair test we should compare the best possible use of the one with the best possible use of the other. The Nernst light can be increased in different directions by proper reflectors, although the light is by far the most part under the horizontal.

Mr. Fleming: Mr. Lansingh sprung that series of questions rather suddenly. The watts per mean spherical and hemispherical candle power—we need these ratings for research work and comparison. But nevertheless we must not go too deeply into that. What good would it do to talk mean hemispherical watts to a man keeping a shoe store? (Laughter.) He would run you out. It is hard enough to talk kilowatt hours. These figures are available, but I do not pretend to carry them in my mind, they are of no practical use to me, and absolutely no use speaking in a board sense as a commercial proposition. It is merely a laboratory question.

With regard to the shadow test. Mr. Dion was not dealing with moon light when he set up a standard commercial illuminant, and he will tell you he had his illuminants equipped in the best possible way to secure the best results. He had the Nernst lamp similarly equipped, there was nothing detrimental to either lamp, they both had a fair show. I will grant that the incandescent is abominably abused, and that is one reason why I brought up the point in my paper about having the central station in closer touch with the consumer. Some storekeepers will point out, with pride, incandescent lamps they have had in the store for seven years. Go to the smaller villages in this country and in the United States and you will find the incandescent lamps hanging bare from the centre of the store, with no reflectors of any kind. You will not find any attempt to get the best results from the lamps, and if they put on a reflector or globe they will in all probability get something that is pretty and useless for illumination purposes. When it comes to the care the lamps get you cannot compare the Nernst with the incandescent lamp. The incandescent is the only fool proof piece of apparatus I know of, and the Nernst is not fool proof any more than the arc is. The Nernst needs attention if you want to get the best results, but if they get the attention they deserve, the same proportionate attention that is given arc lamps, they will give the result.

I am not hedging the question of the mean efficiency per mean hemispherical candle power, etc., etc., and if this convention desires I would be glad to add it as an appendix to my paper, but it is too long a question to carry in my head.

Mr. Schiff: I was going to bring up the same question as Mr. Lansingh as to the hemispherical candle power, as it makes a great difference whether you quote the candle power. Take the higher efficiency lamp, the mean horizontal candle power is nearly uniform all round, and with the aid of some reflector to produce distribution of light it seems to me that it is more uniform than the Nernst. The Nernst lamp gets it on the ends of the glower and the candle power is diminished between them, while at right angles you get a good distribution of glower light, and I would like to ask how these curves are made, whether at the mean or the maximum.

Mr. Fleming: At the maximum, of course. You see the further you go the deeper you get into this thing. In the first place why do you rate an incandescent lamp as it is rated? Because it was found to be the method most advantageous to the incandescent. Now that the Nernst lamp is developed, have we not a right to develop it as we see fit for the best commercial proposition? Has your incandescent lamp as it stands the best form of filament? You will say no. Why look at your Meridian type of lamp. When did they come out? After the Nernst. But before then other forms of filament were thought the best, and now you are coming right around to the lower hemispheric candle power. If it was not good why did you do it? The Nernst lamp came out and people rubbed it into them, up one side and down the other, because we saw fit to change the rating of our lamp from the incandescent, and I claim we have the right to take the most advantageous point, just the same as others. We do not tell other manufacturers how to rate their lamps, and we are going to rate ours where they show to the greatest advantage, and let any of you central station managers take the lamp, do what you want about

the candle power, then go to the store and ask the butcher, baker or grocer what type of lamp he will take.

Mr. Welbourn: During this discussion two or three things have come up that are entirely different to our practice in England. The Nernst lamp is used very largely on continuous circuits, but on many alternating currents there is not one used. The trouble is that the humming has become such a nuisance that they have been entirely removed.

I have seen no reference to the great use of the lamps we have in England, which is found to be good on a single current, but no use on the alternating current, because of the breaking of the films. Take the Tantalum lamp, for instance. I had great trouble with this in my own house on this account, and Siemens, who handled them in England, got tired of replacing them free of charge, and gave it up, sending out a circular saying they could only recommend the Tantalum for single current use.

Mr. Fleming: The question of the Nernst applied to alternating or direct currents goes back to the original lamp developed by Dr. Nernst. In his earlier developments he used a direct current lamp, but when it was brought to the United States and Mr. George Westinghouse took hold of it his engineers found tney could obtain better results from alternating circuits. Consequently there was a sort of agreement which existed between Dr. Nernst and the Westinghouse people that one was to work on the one form and one on the other. I understand that most of the plants in Germany are on the direct current circuit, while outside the larger cities of the United States the field is almost entirely given over to alternating.

The best life of the German lamp, which is the type used in England, from my information, is 350 hours. They make no multiple glower lamps, they make simply a one glower lamp of different current densities. We have found that when you make a heavy amperage glower in the form of a solid rod, the internal heat of that glower seems to disintegrate the interior of the glower, and will ultimately bore a hole through it. It simply vanishes, you cannot find anything left there but a tube. From that experience we proceeded to make a tube. It went on, making a larger tube, and we have abandoned the heavy amperage glower for the present.

The American Company developed the multiple glower lamp, the two, four and six glower lamps, which are our commercial proposition, and I want to impress this fact because in many cases as soon as you mention a Nernst lamp people think of the 88 watt lamp or the one glower type. If we had to exist on the business done in that type of lamp I think we should soon have to shut up shop. It is not a one glower proposition, but one embracing the two, three, four and six glower types.

The President: Mr. Lambe, have you anything to say on this subject?

Mr. Lambe: I have not much to say, as I did not get in for the beginning of the discussion. But I understand that the developments on this side show that the lamp is going to be fairly satisfactory on alternating work of 60 cycles or higher in the larger sizes of lamps. The smaller sizes of lamps have so far proved pretty unreliable on alternating circuits.

Mr. Fleming: With regard to the humming, Mr. Welbourn, did you use the lamp on a direct current or an alternating?

Mr. Welbourn: On an alternating.

Mr. Fleming: The humming is probably due to loose construction, or to improper air gap. There is no reason why the Nernst lamp should hum even on 25 cycles. An individual lamp might hum, but that could be remedied in a few minutes.

Mr. Lansingh: Mr. Fleming's statement relative to rating of lamps on hemispherical candle power for commercial use is, I think, correct, and I should like to endorse his method of rating. Nevertheless, we have to consider the total amount of light given by any illuminant, and in order to do that we must get the mean spherical candle power. If we go into a shoe or grocery store and attempt to put up lamps and recommend them to the customers, the first thing we must know is the relative efficiency of one type as compared with another. But before we can recommend any type of lamp to our customers we must know what they are doing. That is why in the incandescents we substitute Tantalum, Gem or Tungsten for the ordinary carbon filament. Therefore we ourselves must know the relative efficiency or the total flux of light given by any illuminant, whether arc, incandescent, Nernst, or any others.

Regarding the shadow test, I must still stand by what I said. The shadow test unless the sources of light are of the same size is incorrect. If the speaker had spoken of the total amount of illumination in the room, or which room appeared to be the more brightly lighted, I think that would have been a good test. But not the shadow test unless both forms of light were equipped with the same size of glass or whatever else might be employed for diffusing the light.

Again, with regard to the attention given to the lamps. The incandescent is supposed to be fool proof. I am sorry to say it is not. No lamp is fool proof to-day. For example, witness the use of the incandescent lamps in this room, and after looking at them I think you will agree with me that it is not fool proof. We are not getting over a maximum of 60 per cent. efficiency from the lamps in this room owing to the way in which they are hung.

Mr. Fleming: With regard to the test to determine the illumination I agree with Mr. Lansingh, and also if necessary to grade the candle power. The more tests you make the better. Then you realize just what that lamp will do under any conditions. You are thoroughly familiar with it in every respect. You should make every possible test. But as my paper was originally intended as a commercial paper rather than a theoretical or scientific one, I did not deal with these points. The Nernst lamp will enable the central station to get business. I do not think there is a gentleman in this room who does not know from actual solicitation what you have to do with your customers. In Canada as in the States, they all come from Missouri. You have to show them what a lamp will do. They do not care about the scientific curves.

As to the general illumination of a room, that is fixed to a great extent by the position in which your lamp is placed. For instance, the general arrangement of light in this room should be lower down, or provided with reflectors. The arrangement of the lamps as they are is bad.

As to the glassware on the lamps, every manufacturer has the absolute right to place on his lamp what he thinks best, and that is what we always do. We do not care what the arc lamp man puts on his, nor do we want to dictate to him. We put on ours what we think is best suited for the work. We would not think of meeting them in competition by putting on the same as they. Nor would we ask them to put on the same as we do. It is simply a question of equipping your lamp to do the best work and then let it stand on its own merits.

A meeting of the Citizens' Telephone Company was held at Woodstock, N.B., last month, at which it was decided to proceed with the erection of an exchange.

A charter has been granted to the Joliette Light, Heat & Power Company, Limited, to carry on a general lighting business, with headquarters at Joliette, Que.

The City Council of St. Catharines, Ont., will probably give up further negotiations with the Stark Electric Company for lighting the city, in which event the contract will no doubt be renewed with the Lincoln Electric Company.

The new power house of the Maine & New Brunswick Electrical Power Company, situated at Aroostook Falls, was recently formally opened. The plant as now installed is 1,500 horse-power, but provision has been made to double the capacity. The plant will supply the towns of Andover, Perth, Houlton, Presque Isle and Fairfield, all located near the border line.

THE PRESENT STATUS OF THE CARBON AND METALLIC FILAMENT INCANDESCENT LAMPS.

(Continued from Page 22)

tities, but as they are scarcely developed to the point where they may be said to be commercial, they are not considered. There are also a number of other lamps using metals, such as Osmium and Helium, but as they are yet only in the laboratory stage they are outside the limits of this paper.

While the position of the high efficiency lamp is at the present time somewhat indeterminate, there seems no reason to doubt that within a reasonably short time lamps having an efficiency of 1 to 2 watts per candle will be obtainable in standard units and voltages. The introduction of these lamps, though at present of slight moment, bids fair to be a somewhat disturbing factor in the electric lighting business. We have for such a long time been accustomed to selling a customer one thing and billing and delivering another, that we have grown to feel that it is the natural method. Our customers wish to buy light, we sell them energy, and while the amount of energy consumed bears some relation to the amount of light obtained, the relation is far from constant. In the past, on account of the small differences in the efficiencies of the various lighting mediums, this error has not been so important, but with the advent of lamps which can convert energy into light with an efficiency three times what has heretofore been the standard, the matter will require consideration.

The wholesale introduction of high efficiency lamps will undoubtedly cut into the central station revenue to some extent, as although the amount of light required by the ordinary consumer is not measured by him in fixed units of illumination but in dollars per month of cost, he will usually respond to a reduction in price by an increase in its use until the new cost is about equal to the former bill. It is doubtful if this law will hold over such a wide cost ratio as three to one. There is no doubt, however, that to offset such losses in revenue there will be extensions of service to customers who at present cannot afford to use electric light on account of its cost, and though this may bring the load back to the original figure, the business is not so profitable as it will entail more capital expenditure to get and care for.

It would seem that as a measure of protection to the lighting business there should be evolved some method of selling to the customer what he requires, as is done in every other business. Prices for this commodity would then be regulated by the ordinary rules of supply and demand. A change in methods would then entail no hardship either to the consumer or to the company, as the price would, within limits, adjust itself, and the net revenue would remain more or less constant. At present chances in this matter are all in favor of the consumer with the company a bad second, and while I would not think of advocating the making of them all in favor of the company, I do think that a more equitable division than is possible under existing conditions might be arrived at.

Before closing, I wish to acknowledge my indebtedness to the Engineering Department of the National Electric Lamp Association for their kindness in placing at my disposal a great deal of information which is not ordinarily accessible, and which was used as the basis of this paper.

AN IMMENSE WATER POWER ON THE PACIFIC COAST.

The City of Vancouver—"the sunset doorway of Canada"—is daily becoming more widely known as an ideal city, both for progressive business interests and as a most desirable place to live in. As a future manufacturing centre, Vancouver's possibilities are practically unlimited. Not only is it rich in vast deposits of raw material lying at is doors, but probably no city in existence has greater natural power producing advantages. The greatest of these is undoubtedly her electrical power possibilities. Within a radius of 75 miles of Vancouver City there are half a dozen possible water power developments, from which there is a total power available of 250,000 electrical horse-power under low water conditions. One of these is on the Cheakamus river, about 60 miles north of the city, and quite recently a company, composed of local men, was organized under the name of the British Columbia Power & Electric Company to obtain the charter rights to the Cheakamus power. The officials of the company are: C. Gardiner Johnson, president; J. W. Prescott, secretary; F. W. Tiffin, treasurer. These, with Messrs. H. C. Bissett, W. D. Burdis, C. H. Fox and A. Manson, M.P.P., form the directorate. They have not yet decided whether to develop this water power themselves or to dispose of their rights to some other company. They have, however, retained the services of Messrs. Hermon & Burwell, a leading engineering firm in Vancouver, and these gentlemen have reported on its possibilities.

The proposed scheme is, briefly, to develop the water power available at the canyon on the Cheakamus river by means of suitable hydro-electric apparatus, and transmit the electrical energy to Vancouver City and other points. According to the report of the engineers, a flow of water of 4,824 cubic feet per second was found to exist. This is undoubtedly much above the minimum, as, at the time of the examination, the river was about average flow level. Residents in the vicinity familiar with the stream estimate the minimum flow at about one-third less.

The Cheakamus river has an approximate drainage area of 300 square miles, the river also being supplied by rains during the winter and glacier streams throughout the summer, which flow down from the mountains on both sides of the river. There are excellent opportunities for the storage of water, if required, there being several lakes along the course of the river abailable for reservoir purposes, but, with the large flow in the stream, it will be many years before the storage of water will have to be considered.

There are several ways in which the power scheme can be developed. One is to divert the water from the river at the head of the canyon by a specially designed intake, and convey it by tunnel and pipe line a total distance of about 6,000 feet to the power house, located near the foot of the canyon. This would give a total head of 565 feet. Estimating the minimum flow of water at 2,400 cubic feet per second, with this head 104,160 electric horse-power could be developed, allowing 70 per cent. efficiency for water wheels and generators.

The second scheme of development is by diverting water from the river at the most convenient point to flow into Starvation Lake, by means of a tunnel and ditch, having a dam at the outlet of Starvation Lake to raise the level of the water in the lake 25 feet, and constructing a pipe line from the lake to the power house. This would give an effective head of 400 feet and, with a minimum flow of 2,400 cubic feet per second, would develop 74,000 electric horse-power. By this second scheme there would be a loss of 150 feet available head, as compared with the first scheme, but it would have the advantage of a reservoir at the head of the pipe line, which is a most valuable consideration, for the reason that it takes care of fluctuations on the load, prevents formation of anchor ice, and acts as a settling basin to remove sand and silt from the water.

A third scheme of development outlined would be to have the water taken from the river by means of a short tunnel from one hundred to two hundred feet long, and conveyed to the power house by means of wooden pipe. By this scheme, a head of 115 feet would be obtained, and this could be developed for from ten to twenty thousand electric horse-power, provision being made for extension and enlargement of the capacity of the plant as future needs warranted it. This latter scheme could be developed considerably cheaper than the first two outlined.

On account of the silt and rubbage in the water, it is suggested that the water wheels be of the impulse type, such as Pelton or Doble wheels.

The rock formation generally met with in this locality is a volcanic ash rock, considerably shattered and, where natural conditions are favorable, the rock has weathered away and broken down, forming rock slides, some of which are

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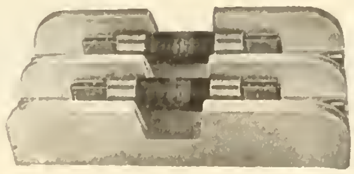

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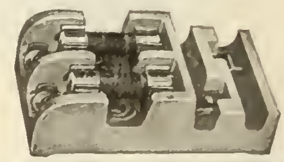

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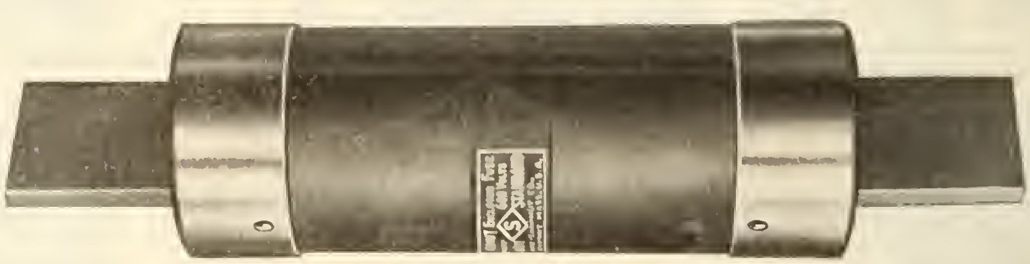

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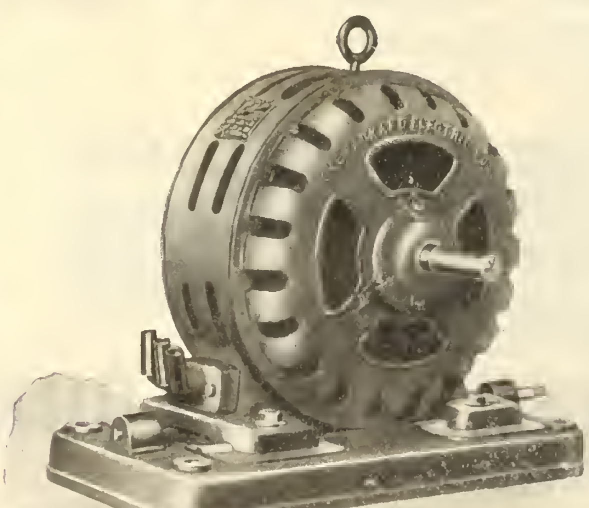

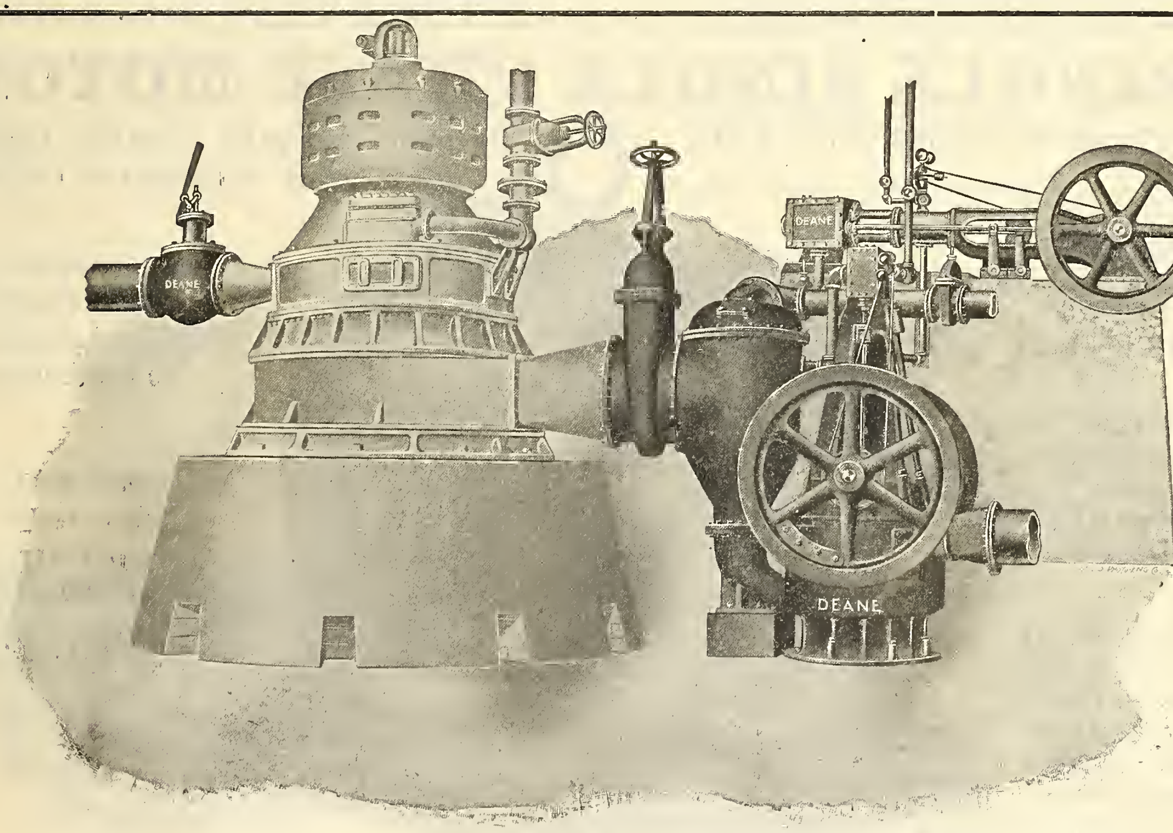
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MOONLIGHT SCHEDULE FOR DECEMBER.

Date	Light.	Date.	Extinguish.	No. of Hours.
Dec. 1	5 00	Dec. 2	5 00	12 00
2	5 00	3	6 15	13 15
3	5 00	4	6 30	13 30
4	5 00	5	6 30	13 30
5	5 00	6	6 30	13 30
6	5 00	7	6 30	13 30
7	5 00	8	6 30	13 30
8	5 00	9	6 30	13 30
9	5 00	10	6 30	13 30
10	5 00	11	6 30	13 30
11	10 10	12	6 30	8 20
12	11 20	13	6 30	7 10
14	0 30	14	6 30	6 00
15	1 30	15	6 30	5 00
16	2 30	16	6 30	4 00
17	3 30	17	6 45	3 15
18	4 30	18	6 45	2 15
19	No Light	19	No Light	
20	5 00	20	7 00	2 00
21	5 00	21	7 50	2 50
22	5 00	22	8 50	3 50
23	5 00	23	9 45	4 45
24	5 00	24	10 45	5 45
25	5 00	25	11 45	6 45
26	5 00	27	0 45	7 45
27	5 00	28	1 45	8 45
28	5 00	29	2 45	9 45
29	5 10	30	3 50	10 40
30	5 10	31	5 00	11 50
31	5 10	Jan. 1	6 10	13 00
		Total............		256 55

The contract for the electric wiring of the new normal schools at Hamilton, Stratford, Peterborough and North Bay, was awarded to Fred Armstrong & Company, Toronto.

SPARKS.

The town of Morden, Man., has purchased the electric light plant from Mr. F. Schneider for the sum of $5,000.

The McClary Manufacturing Company, of London, Ont., have recently installed a producer gas plant for operating their works.

The Okanagan Flour Mills Company, of Armstrong, B.C., have recently installed a 50 h.p. Allis-Chalmers-Bullock induction motor for the operation of their flour mill.

The Georgian Bay Power Company recently completed the tunnel through the Eugenia mountains, work on which was started in February, 1906. The tunnel is 860 feet long and 9 feet square.

The Monarch Electric Company, Limited, was recently incorporated in Montreal, with a capital of $20,000. It is proposed to carry on business as electrical and mechanical engineers. Mr. H. S. Poole is one of the incorporators.

Messrs. Steinhoff & Gordon, owners of the electric light plant at Tweed, Ont., have sold the entire plant and franchise to Mr. J. P. Kissack. Mr. Kissack, with his brother, is the proprietor of the Paisley Electric Light Company. It is his intention to make improvements to the plant at Tweed.

Mr. John A. Whyte, for many years assistant inspector of gas and electric light at Toronto, has been promoted to the position of Dominion inspector. The duties of the new office will be that of a supervisor, working under the direction of the Chief of the Electrical Branch, Mr. O. Higman.

At a meeting of the special committee on power and light of the City of London, Ont., a motion was carried recommending that a by-law be submitted to the ratepayers on January 6th to provide $235,000 for the purpose of erecting a distributing plant for the city and providing for new street lamps and equipment.

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EDITOR'S ANNOUNCEMENT.

Correspondence is invited upon all topics coming legitimately witbin tbe scope of this journal.

The "Canadian Electrical News" is the official paper of the Canadian Electrical Association.

A Commercial Wireless Service

During the past few years Canada has been brought very prominently before the eyes of the world, and this too in almost every phase of human life, whether it be social, atheletic, or financial. Added to these we have recently had the honor of sharing in Mr. Marconi's triumphal inauguration of the wireless telegraphic service, which was lately started between Ireland and Cape Breton. Of course it is some time since the first few words were transmitted experimentally, and in the interval much development work has had to be done, but at last an actual commercial service has been put into commission. This without question marks a most tremendous step in the world's progress, and one on which Mr. Marconi should be most earnestly congratulated, not only on the actual achievement itself, but also on his perserverance in the face of previous failures and other discouragements. As a matter of fact, Mr. Marconi doubtless has still plenty of unsolved problems in front of him, because it is not to be expected that wireless telegraphy will jump into being with a single bound, as a full-fledged and perfect system, any more than was the case with electric lighting or traction. In the meantime, though, let us rejoice that another means of communication has been added to the world's resources, particularly when we remember that our own country was selected to furnish one of the two first stations.

It has been suggested that the inauguration of such a service would mark the almost immediate decadence of all cable systems and the companies operating them. This, however, is scarcely likely, because in the first place it will take some time for a new organization to get into such working condition that it can be a factor in the competition for business, and secondly because it is the general experience that developments such as this gradually create their own special fields, or enlarge those already existing, without interfering very materially with systems already operating. There is apparently room for all, as is evidenced by the fact that the gas business continues to grow, even though electric light is to be had almost everywhere, and that telegraph companies continue to pay dividends, in spite of telephone competition. Doubtless the same principle will hold with Mr. Marconi's achievement.

Higher Efficiency Illuminants

To-day there is probably no branch of the electrical art which is in a greater state of progress than the lighting field. This is due of course to the many new illuminants which just at the present are coming to the front, one after the other, each with claims a little broader than any of its predecessors. In fact some of them may safely be said to have arrived, so that the passing of the carbon filament incandescent lamp, and the carbon electrode arc lamp, is fairly well in sight, though of course the process will take considerable time, even after it has definitely started. In the incandescent field the most promising of the new designs are the Tantalum, Tungsten, and Osram filaments, of which probably the Tungsten will eventually become the most popular. In arc lighting the flame arcs are fairly well established on the Continent for the lighting of streets and large manufacturing premises, and doubtless they will soon become recognized on this side of the water as a distinct advance over the present apparatus, though so far the high cost of carbons and the frequent trimming required have combined to prevent their introduction for very little beyond advertising purposes. Besides this type we have the magnetite and similar forms, developed in the States, which will probably be materially improved upon in the not distant future, and the vapor forms, such as the Cooper-Hewitt and Moore designs. That there is every need for these improvements, and every incentive for designers and manufacturers to produce the better forms, is evidenced by the fact that the ordinary carbon filament has a light-giving efficiency not exceeding say three per cent., the carbon arc perhaps five or six per cent.

Of course, when noting the progress being made, one does not for an instant intend to disparage the old reliable carbon filament, which has done such admirable work, and which in fact was the foundation of the whole electrical industry, since the first plants were entirely for lighting service. Further, it is still the basis for one of the new higher efficiency filaments, namely, the Gem lamp, which is simply the ordinary carbon form passed through a further flashing or treating process, resulting

in a lamp of equal life to the 3 1-10 watt standard Carbon design, and with an efficiency of 2 1-2 watts per candle. This is an advance of almost 20 per cent. in watts per candle, or, put the other way, it means 25 per cent. more light for the same energy. The Tantalum lamp has an efficiency of about 2 watts per candle, with a life on direct current of about 1,000 hours. It is a comparatively easy and cheap lamp to make, that is as compared with the other new designs, which are all materially more expensive than the regular Carbon lamp, and it can be handled with great ease, the filament being not unlike fuse wire to the touch. It has one serious drawback, however, and that is that its life is comparatively short on alternating current. In this respect it is just the opposite of the American Nernst, which latter gives its best performance on the higher frequency alternating circuits, the life decreasing with the periodicity, until on direct current it is so short as to be uncommercial. Contrary to this, the Tantalum filament improves with a decrease in frequency, and with a change to direct current, a lamp which for instance gives 500 hours on 60 cycles lasts about 50 per cent. longer on 25 cycles, and twice as long on direct current. The Tungsten lamp, which has probably not been developed quite as far as the Tantalum, is going to give a satisfactory life at an efficiency of about 1 1-4 watts per candle, and this on either direct current or any periodicity of alternating circuits, a most valuable feature. In texture the metal is almost the exact opposite of Tantalum, being so brittle as to render transportation a matter of great difficulty, though without doubt special methods of packing that will overcome this difficulty will soon be devised. As a matter of fact the point is already negligible in connection with the main class of lamp which is now being made, namely, the street series form, as the short and comparatively thick filaments required for this type are strong enough to stand shipment in ordinary cases with but normal breakage. The Osram lamp, which has an efficiency of about 1 1-2 watts per candle, is comparatively unknown on this continent, though it is used quite extensively in England, where it was developed, and on the Continent. Like the Tungsten, it gives good results on both alternating and direct circuits, and, while fairly fragile, is probably somewhat less breakable than the other. The basis of the filament is the metal osmium. All these new metals have specific resistances very much lower than carbon, so that in order to get the requisite total resistance into a bulb it is necessary to use an extraordinary length of filament, say 20 to 25 inches for a lamp consuming in the neighborhood of 50 watts. In consequence of this, it is extremely difficult to make small lamps, 30 watts being so far about the practicable minimum. As opposed to this disadvantage, all these new developments have one tremendous advantage over the Carbon lamp, and that is that the temperature co-efficient is positive instead of negative. This means that the resistance will rise with an increase of potential and current, thus these lamps are more or less self-protecting against high voltage. Another point in their favor is the superior quality of the light, which is much whiter than from the regular carbon filament.

At the recent Montreal convention there was considerable discussion as to the probable effect that these developments would have on the earnings of central stations, many operators seeming to feel that their revenues might very soon be adversely affected. The answers given were, however, entirely reassuring, and without question are perfectly correct The situation was explained as follows, namely, that if every lamp factory in the country were in shape to-day to turn out these lamps, which is very very far from being the case, all combined they could not replace the present carbon lamps in less than five years at the very least. Then again, even when the lamps have become more or less standard, it is altogether probable that people will take advantage of the increased economy, not by reducing their energy consumption, but by increasing their light consumption. In fact this theory is already proved in the case of the Gem lamp in the States, where they still use a 50 watt lamp as the standard, only it gives 20 candle power instead of the 16 given by the ordinary carbon filament. Further, there is even more comfort in the situation than this, at least for those steam driven central stations that are operating incandescent street series systems, because contracts for such lights are nearly all made on a candle power basis, in which event the increased economy of the new illuminants is of direct benefit to the operating company.

POWER HOUSE UNDER RIVER.

About twelve miles from the city of Baltimore, on the Patopsco River, there is now nearing completion what is probably the most extraordinary power plant in the United States, if not in the world, writes Arthur H. Goldsborough in the "Technical World Magazine." Briefly speaking, the dam and power house are one; in other words, the dam is made hollow and the interior, which is about two hundred feet long and twenty-eight feet wide, is utilized for the generating machinery. At the present time the equipment of the plant consists of two altenators, direct connected to two 500 horse-power horizontal turbines. This will be shortly enlarged by the addition of another turbine and alternator of equal power, bringing the total horse-power of the plant up to 1,500. The interior of the power house, which is constructed entirely of concrete and steel, is remarkably well lighted and ventilated. This is accomplished by the novel construction of the dam, which is formed somewhat in the shape of the letter "S"; the upper portion of the dam slopes at an angle of 45 degrees; this, in connection with the lower slope, throws the excess water flowing over the dam away from the outer wall. This wall is pierced through with many windows, giving splendid illumination to the interior of the power house. These windows can be opened, and one may look out and see the water pouring in torrents over his head.

The Mexican Light and Power Company's Plant at Necaxa

By Alexander McKee.

The Necaxa power house of this company is built in a deep ravine named Salto Grande, which is about 100 miles in an easterly direction from Mexico City, Salto Grande being in the district of Huachinago, Puebla State. Up to 12 or 14 years ago the falls were known to the natives only, as they are situated in a very mountainous and inaccessible country, and even at the present day the nearest railway station, Carmen, on the Hidalgo line, is 30 kilometres from the Mesa, as the camp, where the company's staff live, is named.

View of Power House, With 240 Meter Fall.

For the transportation of machinery and building material the Mexican Light & Power Company built a narrow gauge railway line through the mountain between Carmen and the Mesa, but as the power house is in a ravine about 2,000 feet below the level of the Mesa, the company were put to the necessity of fitting up cages to lower the machinery over the cliffs from the Mesa to the power house. The cages are worked by compressed air engines.

Originally a French company acquired the rights from the Federal Government of Mexico to develop power from the falls, but very little progress was made until the French company was bought out by a Canadian firm, which called itself "The Mexican Light & Power Company." The latter very soon acquired further rights to utilize the waters of the Tenango river and some other small rivulets, and received franchises to supply current for power and lighting purposes in the States of Puebla and Mexico, and subsequently acquired the properties and franchises of the street railway and power and lighting companies in Mexico city, so that at the present time these are all operated from the Mexican Light & Power Company's plants.

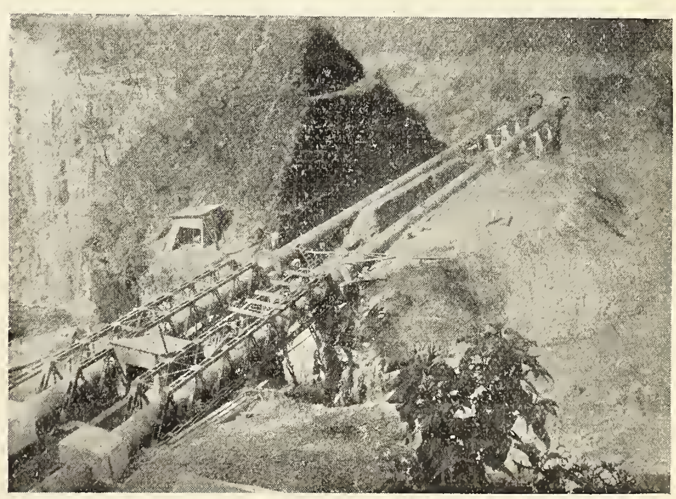
Mexico, like all other countries situated in the tropics, has a dry and rainy season, and the flow of water in the rivers is extremely variable.

The Necaxa river, which was the origin of this scheme, receives its waters partly from a plateau which is about 8,000 feet above sea level, and partly from the slopes that fall abruptly from the plateau towards the east. The power house is situated where the Necaxa has its source, the site being about 5,000 feet lower than the plateau.

The river as it enters the Salto Grande ravine has a perpendicular fall of 240 metres, and this fall, with the addition of another of 90 metres which is a half mile further up the river, and the intervening rapids, supply the hydro-static head for the Necaxa plant.

Heavy rainfalls as high as 135 inches in the year are caused by the high state of saturation in the air rising from the Gulf of Mexico and coming in contact with the cooler air of the mountains. That the irregular flow might be utilized to its full extent for a plant which has a capacity equal to the mean flow for the year, the excess flow of the water during the rainy season is accumulated in three large reservoirs, which have a total capacity of 135,000,000 cubic metres.

The reservoirs were constructed by means of three large earth dams, situated at convenient points in the valleys through which the rivers pass. The method of constructing the dams was by the sluicing process which



Showing the Two Large Pipes, Run Partly in the Open and Partly Through Tunnels

was first put in practice by the Californian gold miners. It consists in diverting a good head of water to a point near the site of the dam and then by means of flumes and pipes, which are laid on scaffolding for the purpose, large quantities of stone and earth, loosened by blasting, are washed down to the dam site, where against masonry toes all the solid material is deposited and the water run off. The process so arranges itself that the stones and heavier material stay at the outside while the lighter material settles to the inside of the dam.

The flow of the Necaxa river during the dry season is one cubic metre per second, according to the company's records, but this tiny rivulet becomes a swollen torrent during the rainy season, and on the 20th of August, 1906, the flow reached 148 cubic metres per second, which is the highest recorded.

At the end of the Necaxa reservoir a tunnel one kilometre in length is run to the Tenango river, which at this point runs parallel with the Necaxa river, and by means of a diverting dam all the waters of the Tenango are turned into the Necaxa reservoir.

The hydro-static head is obtained by taking the water from the Necaxa reservoir by means of two pipes having diameters of 8 and 6 feet. The pipes are partly run in tunnels and partly in the open to a receiver, which is placed just above the level and to the right of the 90 metre fall. From this receiver six steel pipes, 30 inches outside diameter, are run through two tunnels which end close to the power house. From the Necaxa reservoir to the nozzles of the waterwheels the total fall is 1,350 feet, this fall giving a pressure at the nozzles of 580 pounds to the square inch.

The two large pipe lines are built of boiler plates, rivetted together and fitted with expansion joints at three places. The inlet to these pipes from the reservoir is by means of two vertical pipes set in concrete. Each vertical pipe has four gates, protected by screens at different levels. By reason of this it is never necessary to open the gates under pressure.

The receiver, into which the two large pipes lead, is fitted with a combination of valves to allow of the 30 inch pipes to the waterwheels being all fed from one large pipe, or the water can be divided so as to allow of each 8 foot pipe supplying three of the 30 inch pipes.

The six 30 inch pipes are in 30 foot lengths, with flanged ends, and although the outside diameter is uniform throughout the whole length of the pipe line, the inside diameter is slightly tapering, giving the pipe a greater thickness as the static head and pressure increase.

Temporary Reservoir at Lagima.

The power house, 200 by 90 feet and 65 feet high, is constructed solely of iron work and concrete, with a galvanized iron roof supported by steel trestles, this making a solid fireproof building. The pipe lines enter the building at the basement, and each pipe is fitted with a gate valve and bye pass as it enters the wheel pit. The waterwheels, six in number, were manufac-

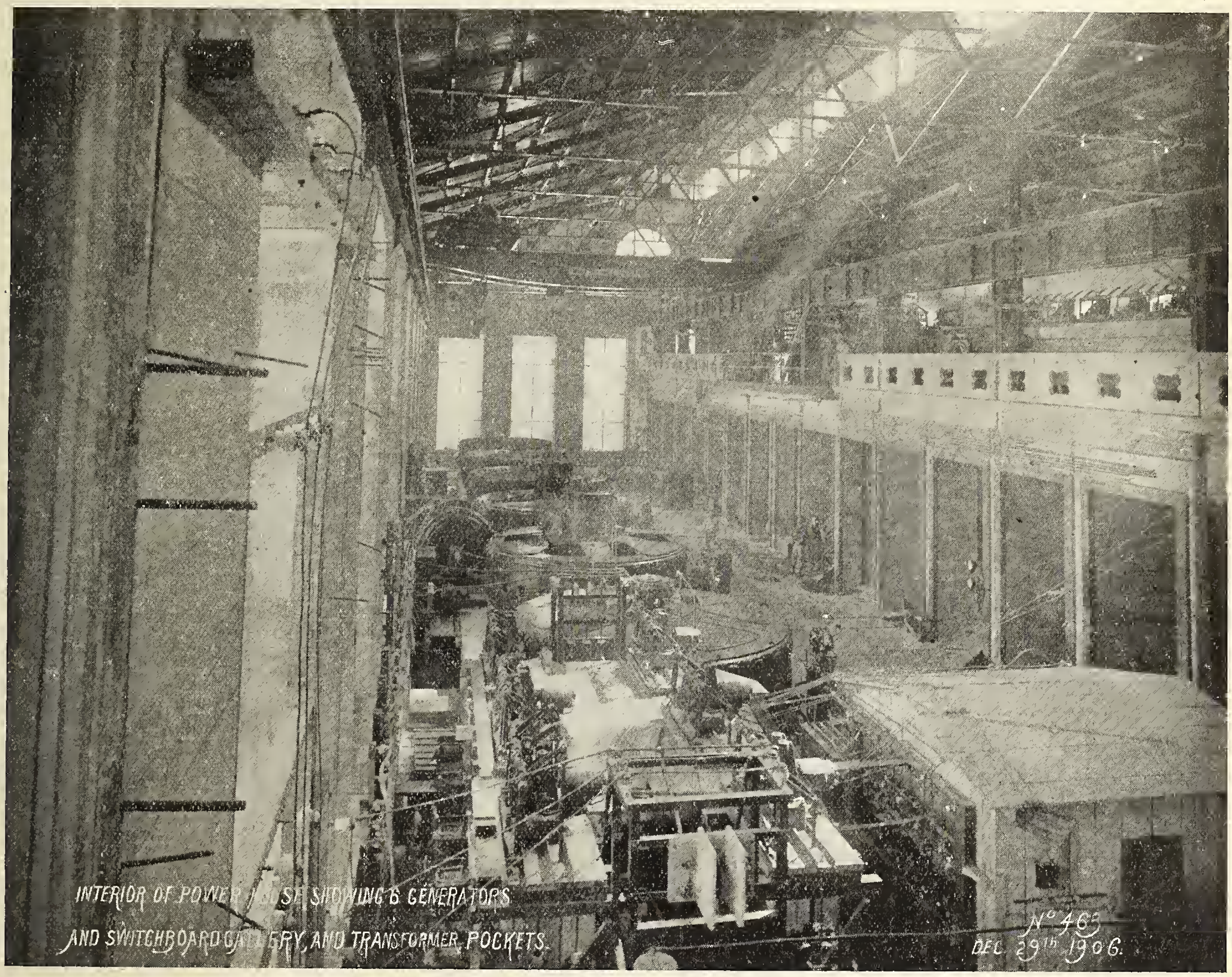
60,000 Volt Oil Switches.

tured by Escher, Wyss & Company. They are of the impulse type, 2.90 metres in diameter, and carry 24 cast steel buckets, against which the water plays from two nozzles set diametrically opposite. Under normal conditions each wheel is capable of developing 8,200 horse-power. The nozzles have rectangular openings, and are 4 1-2 inches by 4 1-2 inches when fully opened. They are regulated by means of a universal governor, supplied by Escher, Wyss & Company. Situated in each wheel pit at the end of the pipe line is a safety valve. The valve is regulated by the governor, so that in case of suddenly or even partly closing the nozzles the valve is opened and relieves any dangerous pressure in the pipe line.

The six machines are of the vertical type, having the step bearing between the waterwheel and the magnet wheel. Th oil pressure for the step bearing and the governor is supplied from a three throw pump, each machine having an independent pump. The oil is delivered both to the step bearing and governor at a pressure of 360 pounds, and this pressure, forcing its way out through the step bearing, has the effect of lifting the whole machine three millimetres, thus letting it run on a thin film of oil.

The generators are of the rotating field type, and are wound for three phase currents at a pressure of 4,000 volts, each generator having a capacity of 5,000 kw. They were supplied by the Siemens Schukert Werke Company.

The exciting current is taken from two 200 kw. induction motor generators, the generators being wound for 100 volts and fitted with commutating poles. Each exciting set is fitted to a Pelton waterwheel fed from an independent 10 inch pipe, run from the receiver alluded to. This pipe also supplies the water for the oil pumps. In the ordinary course of running the exciters are driven by the Pelton waterwheels, but the induction motor is also floating on the bus bars. The advisability of this will be understood when it is stated that the nozzles for a Pelton wheel of this size, running under a head of 1,400 feet, have a very small opening, and the slightest foreign matter, such as grit, would immediately affect the speed. On the other hand, if the exciters depended on being driven by the alternating current only, there would be the risk of lowering the speed or even blowing the fuses in the event of a heavy short circuit on the system.



View in Power House at Necaxa.

The transformers, fifteen in number, were built by

the General Electric Company. They are of the single phase type, oil insulated and water cooled, and have a capacity of 2,000 kw. each.

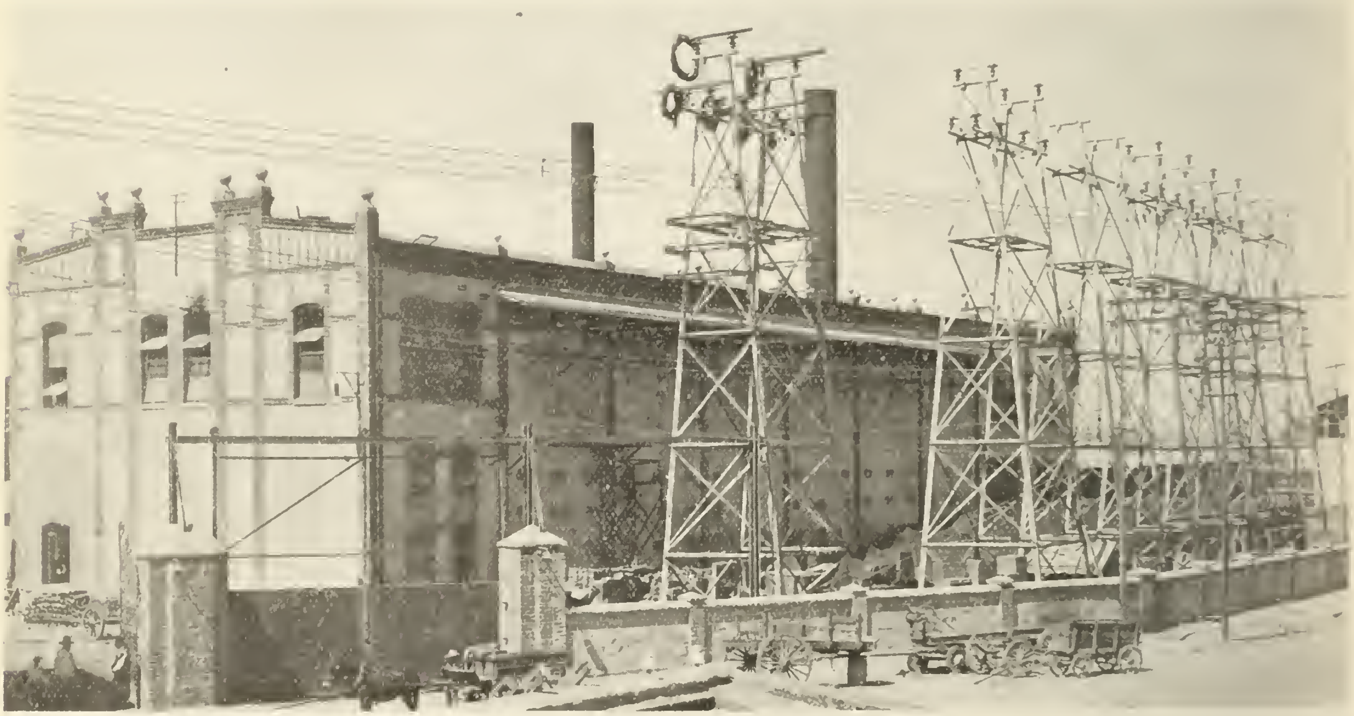
Three transformers, delta connected, are joined up to each of the four transmission lines, leaving a spare bank that can be thrown on to any of the lines. The transformers are placed in separate fireproof compartments that are built beneath the switchboard gallery, each transformer being connected to a pyrometer that is placed on the switchboard gallery so that the attendant can always know if the temperature is normal.

The switchboard gallery runs along the whole length of the building, and on it are mounted in fireproof compartments the 4,000 and 60,000 volt switches, which are of the oil break type, fitted with time limit relays. The switches are operated from a remote control board that occupies a very small space and is situated in the centre of the gallery, from which point the operator is able to watch and control the whole station. The volt meters and ammeters for the different machines are also mounted on the remote control board. All the switch gear was supplied by the Canadian General Electric Company, but the erection, as well as all the construction work connected with the system, was carried out by the construction staff of the Mexican Light & Power Company.

The 4,000 volt lead covered leads for the generators and transformers are run separately in fireproof conduits, the 60,000 volt leads from the transformers, being run on tower insulators underneath the switchboard gallery and thence to the 60,000 volt switches. The overhead lines leave the station through rectangular apertures, the line being secured to a tower insulator as it passes through the aperture. A lightning arrester of the low equivalent type is fitted to each cable of the four lines just before they leave the station.

The transmission lines, four in number, are made up of six strands of copper with a jute core, the sectional area of the cable being equivalent to 000. The lines are run on steel towers heavily galvanized and a standard spacing of 500 feet is used except in crossing chasms or mountain sides in which case the spacing is considerably greater. In a mountainous country like Mexico, steel towers are preferable to wooden poles, as the towers can be taken apart and packed in bundles and transported on mules to their positions along the route, which for the most part runs through a very wild and rugged country.

The length of the transmission line from Necaxa to the Nonoalco distributing station in Mexico city is 153 kilometers. From here a portion of the current is further transmitted in a westerly direction to the El Oro and Esperanza gold mines, about 122 kilometers from Mexico city, so that the total length of the transmission is 275 kilometers.



Distributing Station at Nonoalco, Mexico City.

Including the Necaxa plant, there are two steam plants, San Lazaro with a capacity of 3,000 k. w. and Nonoalco with a capacity of 7,000 k. w., Nonoalco is the distributing point for all the plants and from it are run the feeders for the street railway substations, and the power and lighting circuits. The current for the El Oro and Esperanza mines is transmitted at 60,000 volts to a substation at El Oro and is then transformed down to 3,000 volts for synchronous motors of 500 k. w. each that are used for driving the stamp mills, and the current used for smaller motors of 50 horse-power and under, that are used for pumping purposes, is transformed down to 440 volts.

THE RESPONSIBILITY OF ELECTRICAL COMPANIES FOR ACCIDENTS*

By Geo. H. Montgomery.

Notwithstanding the well recognized efforts which are made by practically all persons and companies engaged in the supplying of electricity, accidents will and do occur causing great loss of life and property. The highly dangerous character of the article supplied, its invisibility and the difficulty and in many cases the impossibility of determining in advance the existence of conditions creating a source of danger, the fact that the appliances used in the distribution are scattered over so wide an area and situated frequently in the premises and under the physical control of third persons over whose acts the company can exercise no supervision, places electricity in a class almost by itself as regards the difficulty of the task imposed upon those engaged in its production and distribution. With these inevitable conditions, the failure of appliances to perform the functions which they are relied upon to fulfill, the carelessness of employes, and more frequently the reckless imprudence and gross negligence of the public, afford very easy channels for the arrival of accidents against which human foresight cannot adequately provide. This being so, it is felt that a paper dealing with the legal responsibility of electrical companies for such accidents must be of interest to the members of this Association, particularly in view of the widely divergent opinions which have been expressed by the various courts in the comparatively few years during which the distribution of electricity for purposes of lighting and power has been in vogue. The present paper lays no great claim to originality other than an attempt to reconcile these decisions where reconciliation is possible, and to extract from them certain principles which should at this stage be capable of more or less exact definition.

Inasmuch as the distribution of electrical current is almost entirely in the hands of incorporated bodies, a few preliminary remarks as to the legal position of companies authorized by their charters to produce and distribute electricity may be in order. In the first place, it is now a well recognized principle that when Parliament authorizes a person or company to do a particular thing, the mere exercise of the right conferred cannot, in itself, render the company responsible for the damage which the exercise of the right may cause to others unless there has been some failure on the part of the person or company upon whom the power has been conferrerd to perform some of the duties expressed or implied attached to the exercise of the power granted. In other words, notwithstanding the extremities to which courts of justice have in some cases gone in defining the position of those engaged in supplying electricity, they are not insurers against accidents, but, at the most, are only bound to adopt every approved means of precaution and to exercise a degree of care commensurate with the danger. Thus in a case recently decided by the Supreme Court of Canada in re Gloster vs. Toronto Electric Light Company, 38 S.C.R., page 27, it is remarked:—

"The defendant company transmitting such a dangerous element as electricity through their wires thus strung along the public highway fall short of being insurers, but are bound to exercise the greatest possible care and to use every possible precaution for the protection of the public."

Idington in the same case lays down the rule as follows:—

"The statute enabling the company to use the public highway enables them to maintain works so constructed and must, I think, be taken by implication to mean a maintenance in a proper manner so as not to become a public nuisance."

A large number of earlier decisions went to the extent of enunciating the principle that a company introducing a new element of danger for their own profit and use was in the position of a person keeping a ferocious wild beast upon his premises, which, if it escaped and caused damage, would render the owner responsbile, whether it escaped through his negligence or not. This doctrine, however, is not in accordance with more recent thought upon the subject, since it would have the effect of declaring an actionable tort that which Parliament had expressly authorized.

Before passing from this subject reference might be made to a recent decision of the Judicial Committee of the Privy Council in the case of Dunphy vs. The Montreal Light, Heat & Power Company, in which judgment was rendered only a few weeks ago. In this case the company, by its charter, was authorized to enter upon and construct either under or over the streets and public highways all such pipes, lines, conduits and other constructions as might be necessary for the purposes of its business. A contractor had erected a derrick in dangerous proximity to one of the transmission lines of the company, erected overhead and carrying a pressure of between four and five thousand volts. The company had warned the contracter of the danger and had seen that the arm of the derrick was anchored in such a way as to prevent its coming into contact with the wire. Upon the occasion of the accident the contractor's foreman, in order to facilitate the moving of a stone, had taken the chain off the arm of the derrick; the result being that the current ran down the wire cable of the derrick and through the man who was operating the winch. The foreman and the plaintiff's husband (who was a passer-by) rushed to the assistance of the workman at the winch and both were killed instantly, while, strange to say, the workman who re-

*Paper read at the Annual Convention of the Canadian Electrical Association.

ceived the first shock received injuries so slight that he was able to give evidence at the inquest. The learned judge presiding at the trial instructed the jury that the company, being authorized by its charter to erect its lines in either of two ways, that is to say, either overhead or underground, was bound to adopt whichever method afforded the greatest protection to the public, and that if it failed to do so, it would be responsible for the consequences. The jury accordingly exonerated the contractor and condemned the company, the principal ground being that it was guilty of negligence in not placing the wires underground instead of overhead. This judgment was confirmed by the Court of Review for the same reasons. It was, however, unanimously reversed by the Court of Appeals, who held that where the company was authorized to adopt either one of two methods, that it had the absolute right to adopt whichever of the two it saw fit. The case was then carried to the Privy Council, with the result that the judgment of the Court of Appeals was affirmed for the same reasons, and the plaintiff's action against the company dismissed.

Degree of Care Required.

As has been stated above, while the company distributing electricity is not an insurer against accident, it is held to a certain degree of care. As to what that degree of care is various expressions have been made use of. Thus in the case of Gloster vs. Toronto Electric Light Company, above cited, it was stated that the company was bound to exercise "the greatest possible care and to use every possible precaution for the protection of the public." Other expressions have been made use of by American courts, such as "highest degree of care," "highest degree of care commensurate with danger," "high degree of care," "very great care," "reasonable care," "all care that a reasonable person can take," "ordinary care and skill," "at least ordinary diligence," "only ordinary, depending upon circumstances," etc., thus affording a text for almost any proposition which the hard-pressed lawyer might require to suit his particular exigency.

Between these wide extremes of opinion the most generally accepted, and, it is submitted, the most logical, is that the care required can only be defined as a degree of care commensurate with danger. In the application of this principle the subject divides itself, on the one hand, into the degree of care required in construction and appliances made use of as distinguished from the degree of care required in maintenance and operation, and, on the other hand, into the degree of care required by a company as towards its employes and as towards its customers as distinguishing from that required as towards outsiders generally.

As to the protective devices to be made use of, it was held by the Supreme Court of Canada, in the case of the Citizens' Light & Power Company vs. Lepitre, 29 S.C.R., p. 1, "that persons dealing with dangerous material are obliged to take the utmost care to prevent injuries being caused through their use by adopting all known devices to that end, and where there is evidence that there was a precaution which might have been taken by a company making use of electrical currents to prevent live wires causing accidents and that this precaution was not adopted, the company must be held responsible for damages." This ruling, however, was criticized by Mr. Justice Nesbitt in a later decision of the Supreme Court in the case of the Montreal Park & Island Railway Company vs. McDougall, 36 S.C.R., p. 1, where he says: "I desire to draw the attention to the fact that the headnote of the case of the Citizens' Light & Power Company vs. Lepitre is based merely upon an oral opinion of the Chief Justice in that case. That expression was not necessary to the decision of the case, which simply proceeded upon the fact that the company had failed to provide ordinary appliances in such a dangerous work. I certainly would not concur, as at present advised, in the expression of opinion by the Chief Justice. I think the doctrine there laid down is only applicable as between a company carrying on such a dangerous employment and third parties."

"I do not, myself, see any difference between an employe of an electric company and any other employe, other than that, owing to the extreme hazard of the work, precautions proportionately commensurate with the danger would have to be taken by the employer under the ordinary rule of law requiring reasonable care. The duty is the same in each case: the evidence of the performance of the duty must necessarily vary according to the circumstances."

The ruling is, moreover, inconsistent with a decision of the highest court in England in the case of the National Telephone Company vs. Baker, where it is held that a company is not bound to immediately adopt every protective device which comes upon the market. It is only held to a reasonable diligence in adopting such as have been thoroughly tried and approved. It is, moreover, difficult to see what distinction is to be drawn between electrical companies and railway companies as regards the adoption of safety appliances. In the case of railways it has been frequently decided that the mere failure to adopt such well-known devices as automatic couplers would not, in itself, constitute such negligence as to render the company responsible for accidents, but would simply impose upon the company a greater degree of vigilance in protecting its employes.

The duty of a company as regards insulation has been defined and illustrated by the Editor of Electrical Cases as follows:—

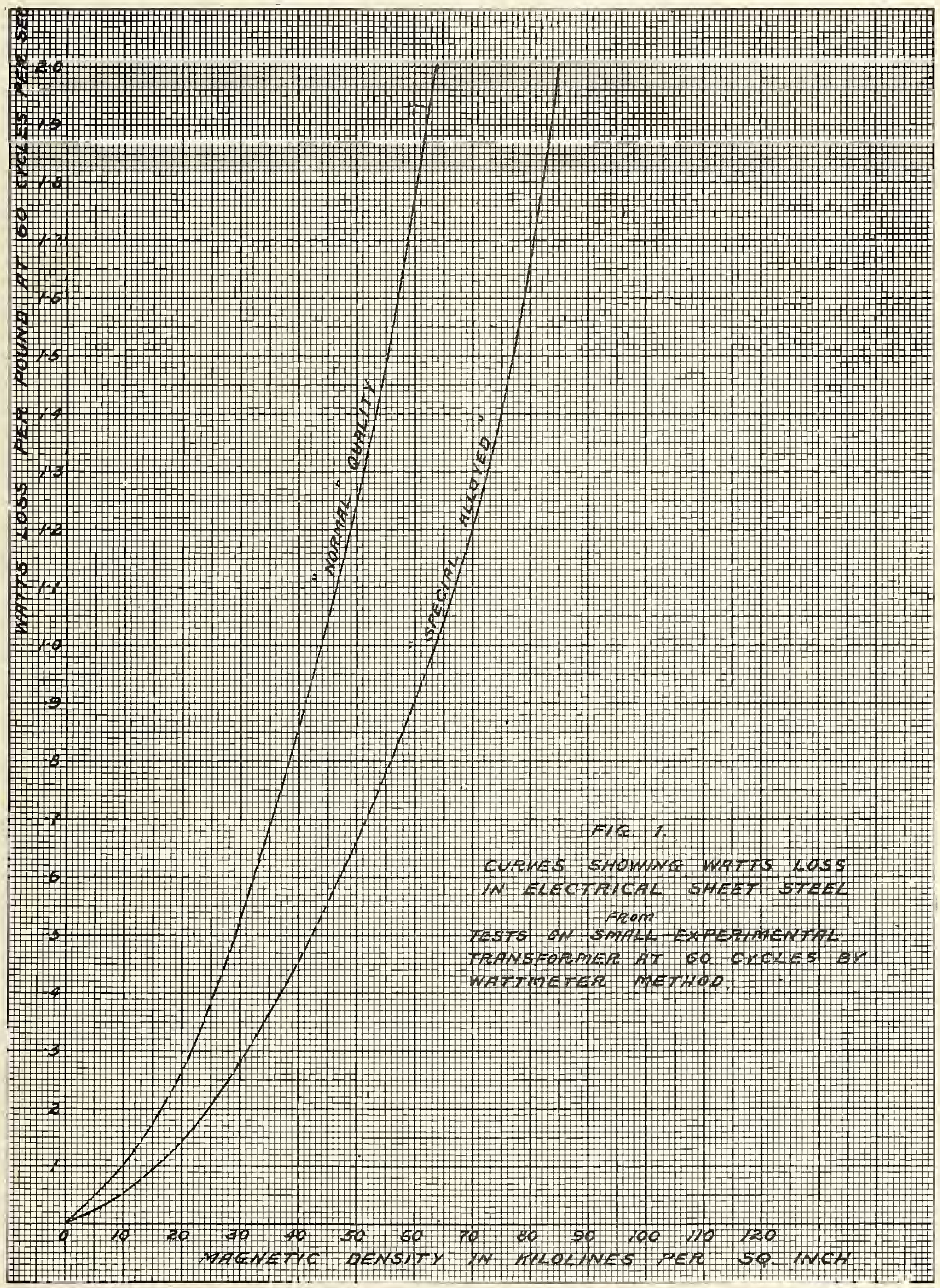
"Bearing in mind that reasonable care under the circumstances is the fundamental requirement, it not only follows that a very high degree of care should be required to keep electric wires properly insulated in places where persons may be reasonably expected to be; but follows none the less logically that a much less degree of care is requisite in places where persons are not reasonably expected to go. Thus electric companies have been held not liable for injuries occasioned to a person walking upon the girder of a bridge many feet

(Concluded on page 28).

MODERN LIGHTING TRANSFORMERS*

By G. P. Cole.

The great improvements effected in the design of the lighting transformer several years ago, and the great amount of attention paid to this piece of apparatus branches of the electrical industry, it would be unfair to assume that the art of transformer design had remained stationary. The result is, we now find on the



at that time, seems to have caused an impression that the lighting transformer had reached the acme of perfection, and was incapable of much further improvement.

However, with the great advances made in other market lighting transformers that in almost every respect are ahead of those designed only as far back as two years ago.

It is instructive to note in what manner these improvements have been effected.

The following remarks will apply, of course, to trans-

*Paper read at the Annual Convention of the Canadian Electrical Association.

formers of the "core" type, since it is no longer necessary to point out the advantages of this type where purely lighting loads are concerned.

In attempting to effect an improvement, the designer should always bear in mind that the lighting transformer has, in almost every case, to be placed on a pole, and should weigh as little as possible, but still possess the desirable characteristics of high insulation, good regulation, high efficiency, small core loss, small rise of temperature and low first cost. In other words, he must increase what might be called the "specific utilization of material," that is, the "weight of active material per kilowatt output" must be reduced. To accomplish this it is quite evident that a sheet steel of low core loss must be used.

Within the last couple of years several sheet steel manufacturers have produced special alloyed sheet steel of low watts loss. Fig. 1 shows a curve of "special" sheet steel for electrical purposes of one manufacturer, giving watts loss per pound in relation to magnetic density. In the same figure is also shown a similar curve for sheet steel of "normal" quality by the same manufacturer. The great superiority of the special alloyed iron is at once apparent.

With a low watts loss iron, a higher density for the same core loss can be used. Thus the number of turns of the coils can be reduced, giving a shorter copper circuit and consequently a smaller copper loss. A reduction in the number of turns also results in more room for the copper circuit. Thus a greater cross-section of copper can be used, the C^2R loss is diminished, and the efficiency and regulation thereby improved.

The reduction of the number of turns in the coils also tends to improve the regulations because, in the formula for reactance voltage of a transformer, the numerator contains the number of primary turns squared, and as the reactance voltage appears in two places in the formula for regulation it is easily seen that reducing the number of turns will have a marked effect in improving the regulation.

From the central station point of view the desirability of close regulation is as important with lighting transformers as it is with transformers required chiefly for motor loads. Although close regulation was not of such vital importance in the old days of flat rates, now that almost all central station business is done on the meter basis, it is fully as important from an economic point of view as high efficiency, for the following reason:—

The voltage drop due to the transformer does not necessarily mean a loss in power generated. It does, however, result in an appreciable loss in power as measured at the consumer's meter, since the power recorded is almost in direct proportion to the voltage at the meter. From this it is seen that the voltage drop due to transformer regulation is practically equivalent to a proportional loss in power at meter rates. If the regulation of a transformer is poor, the central station is deprived of revenue and the consumer gets poor service. This latter effect often results in loss of revenue through the time lost by officials in pacifying kickers

The magnetic circuit of the modern lighting transformer is made up of rectangular sheet steel punchings with interlocked joints. The punchings are insulated from one another by a special insulating varnish and as the special alloyed iron is inherently of high resistance, the eddy current loss is reduced to a minimum. The interlocking of the joints gives the best possible magnetic circuit and prevents vibration and humming.

The question of the "ageing" of the iron is not the bugbear that it was a few years ago. The results of recent tests show that ageing is apt to result if the core is subjected to too great mechanical restraint, and at the same time continued heating at moderately high temperatures. In lighting transformers of the present day, no trouble need be feared from ageing, as the core plates are not clamped too tightly and the operating temperatures are comparatively low. Ageing is only due to a rise in value of the hysteresis loss, and has been shown in even the worst samples of sheet iron to occur hardly ever below 80 degrees Centigrade. Such operating temperature is rarely, if ever, met with in lighting transformers. The rules of the German Electrotechnical Society define ageing as the percentage variation of the figure of loss (which is the watts loss per kilogram at a density of 10,000 lines per square cm. and 50 cycles per second) caused by keeping the sample at a temperature of 100 degrees Centrigrade for over 600 hours. There is no difficulty in obtaining sheet steel whose ageing wil be within a maximum of 15 per cent. even under these severe conditions. Especially is this true of the special grade of alloyed sheets.

The exposed position of the coils in the core type of transformer has long been recognized as very advantageous in dissipating the heat generated in the coils, but at the same time it leaves them in a dangerous place for receiving mechanical injury during assembly and afterwards, when the cover is removed. Sometimes protection is afforded by taping the coils heavily in a manner similar to that employed for taped field coils of d. c. machines, but this method interferes with the emission of heat from the coil surfaces. The difficulty is overcome in modern transformers by thoroughly impregnating the coils with a special compound possessed of high heat emissive qualities. This treatment of the coils is accomplished by means of a vacuum impregnating apparatus and when the coils are thoroughly impregnated and dried they form a solid mass that will resist any mechanical injury that would ever be likely to occur. The impregnating compound, as it were, converts the cotton covering of the wires and the coil insulation into a solid mass which has much better heat dissipating qualities than the plain cotton covering of the copper and the untreated layer insulation.

Some of the advantages of impregnated coils over coils treated in the ordinary manner with a solvent varnish are as follows:—

Ordinary cotton covering and fibrous material used in covering wire and the winding of coils, carry sometimes as high as seven to ten per cent. of moisture. In the ordinary method of dipping these coils in a cold

varnish and afterwards drying the varnish under heat, the moisture is sealed in the coil, thus tending to lower the dielectric strength of the covering of the wire and cause an ever-present danger of burn-outs. Besides, in the ordinary method the varnish penetrates but a few of the outside layers of the wire, thus leaving the inside layers of the coil without the reinforced insulation which the varnish is supposed to give to the cotton covering. With vacuum-treated coils, these conditions are reversed. The coils are wound in the ordinary manner, assembled on the legs of the core and the magnetic yokes then placed in position and held by the core end plates. The core and coils as a unit are then placed in a steam-heated, air-tight chamber, which is connected through a condenser with a vacuum pump. The moisture in the cotton covering of the wire and the fibrous material used in the construction of the coils is vaporized at a comparatively low temperature and drawn from the chamber and condensed in a specially constructed condenser. The moisture and air are quickly removed form the coil insulation materials and this leaves the coil in the very best possible condition to receive the previously liquified solid insulator used for the insulation of coils in vacuum.

The time required for drying and filling of coils varies from four to six hours, depending upon the depth of wire in the coils. The vacuum apparatus used consists of a closed vacuum chamber connected by piping with an open liquor tank. The liquor tank is supplied with large heating surface, steam being usually employed, and the solid insulator is placed in this tank and brought to a liquid state by means of heat. The transformer coils in the meantime have been dried out in the vacuum chamber, and the line connecting the two chambers is opened and atmospheric pressure forces the liquid compound into the vacuum chamber and over the previously dried coils. The line is then closed and air pressure of 60 pounds to the square inch is used to force the compound in to the cotton covering and between each turn and layer of wire in the coil. The hot compound is thus allowed free access to the interior of the coil and being filled in a vacuum, the air, which is a very poor conductor of heat, is entirely excluded from the coils. The coils after having been impregnated are taken from the vacuum chamber and allowed to cool in the open air. There is no baking of the coils necessary, as the drying of the compound is a cooling process, the material simply returning to its natural state. The advantage of impregnating the coils after they have been placed on the legs of the core, lies in the fact that all danger of injuring the coils in assembling is entirely done away with. The above described process not only turns out a coil which is impervious to moisture and oil, but provides a superior

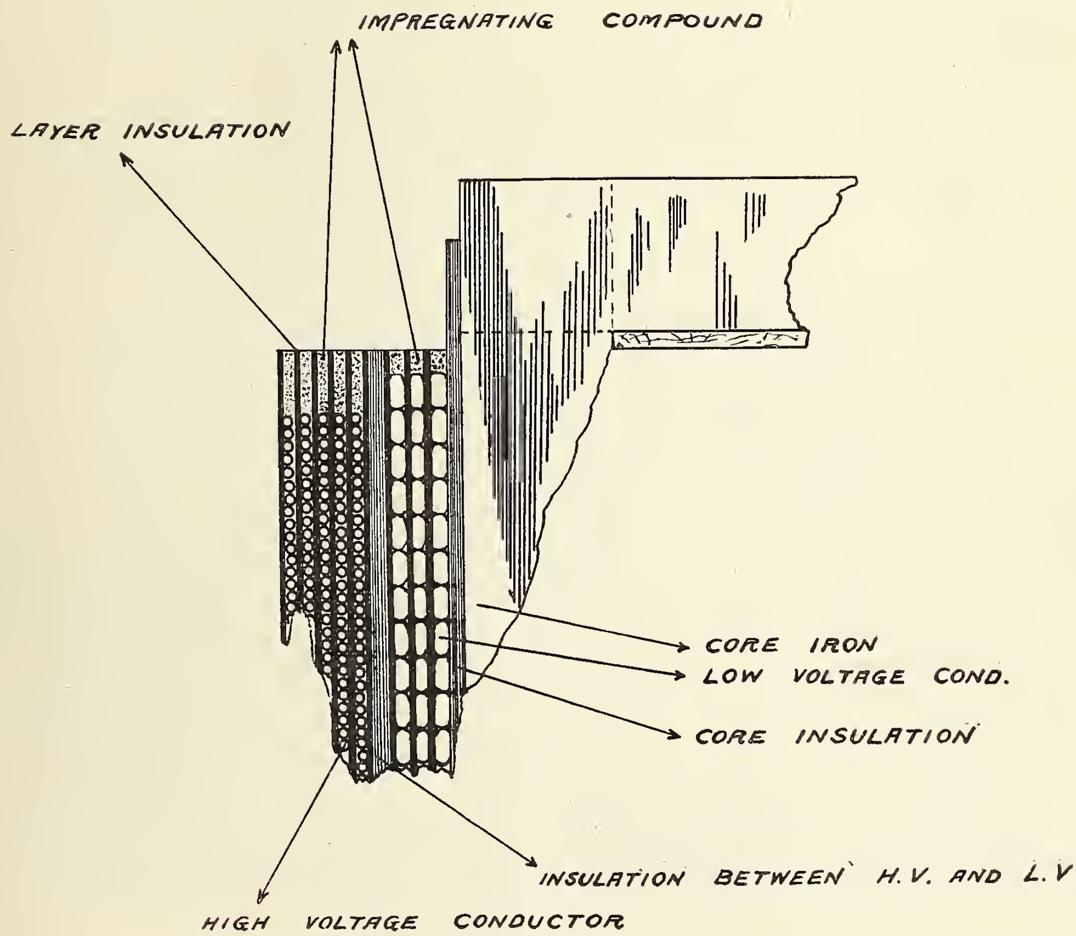


Fig. 2.—Showing Manner in which Impregnating Compound Fills All Spaces and Protects the Coils from Injury.

coil in many other ways, the compound having cemented each turn and layer of wire in the coil, thus preventing abrasion of insulation and burn-outs from vibration, and as before mentioned, also providing superior heat dissipating qualities.

It is difficult to obtain exact figures of how much the impregnating helps in the dissipation of the heat from the coils, but it seems to be in the neighborhood of 20 to 25 per cent. In other words, a transformer that has had its coils impregnated will run 20 per cent. cooler than one whose coils have not been treated. The result in the temperature rise under normal operating conditions is quite low, and the temperatures of the several parts of the transformer assume a more even figure, no one part showing an abnormal rise over any other part. The advantages resulting from low operating temperatures are too well known to require pointing out.

The manner in which the impregnating compound fills all spaces and protects the coils from injury can be clearly seen in Fig. 2.

With regard to mechanical features we note several improvements over the older forms of lighting transformer.

The top core end plate is so constructed that it allows the oil to come in contact with the core as much as possible, thus giving the maximum cooling effect.

The top plate is provided with lugs so that the transformer can be quickly removed from or lowered into its case.

In capacities above 10 or 15 kw., corrugated cases are used. These in the modern lighting transformer are usually made of terne sheet, which gives the maximum of radiating surface with the minimum of weight.

THE ELECTRICAL EXHIBITION AT MONTREAL.

(Concluded from November Issue.)

Fred. Thomson & Company.

An attractive feature of the Show was the booth of Fred. Thomson & Company, where a number of interesting experiments with induced currents were repeated during each afternoon and evening. Messrs. Fred. and Clarence Thomson, one of whom was usually on hand, were submitted to rapid fire questioning and called upon for numerous explanations of the phenomena.

The front of the booth was arranged as a sort of lecture table. A flat coil of D. C. C. magnet wire of about fifteen inches diameter was placed on the table and had its ends connected to a 110 volt A. C. circuit; on it was laid a piece of plate glass to show that there was no connection between this coil and any other coil which might be brought near to it, and the glass was covered with a piece of cloth to protect it. First a coil having its ends connected to a 14 volt incandescent lamp was held in different positions above the first coil, and it was explained how the lines of force set up by the current passing through the first coil threaded this coil and in consequence induced currents were developed in it. It was made clear that the second coil had to be placed in such a position that the lines of force would cut it, as otherwise the lamps would not light up and the varying candle power testified to the varying number of the lines of force cutting the coil in the different positions in which it was held. The lamps would light up when the second coil was held at a distance of six inches from the first coil, and this distance was increased to nearly two feet when an iron core of about this length was placed over the centre of the first coil and the second coil placed just above the iron core.

A coil connected to a 52 volt lamp was placed at the bottom of a large glass bowl (an arc lamp globe) and held over the first coil, and another coil connected to another 52 volt lamp in a similar bowl filled with water was used to demonstrate the fact, by the lighting up of the two lamps, that the lines of force passed through the glass and through the water. A small coil was enclosed in a mahogany box and the lamp to which the coil was connected lighted up when the closed box was held above the first coil.

Another large coil wound with large wire had its terminals connected to ordinary arc carbons and when this coil was placed over the first coil an arc could be drawn between the carbon points.

After a few other short experiments with nails, staples and a brass ball, the cloth and plate glass were removed and another flat coil weighing about 25 pounds was placed on top of the first coil. It was shown that when the ends of the coil were brought together and the coil short circuited, the two coils tended to oppose each other, and if one portion of this coil was supported firmly about one-half inch from the first coil the remainder of the coil was pushed away from the first coil and floated practically unsupported. With this coil short circuited, it was almost impossible to put it down exactly over the centre of the first coil.

Messrs. Thomson & Company, who do perhaps the largest electrical repair business in Canada, had also a display of form wound coils, surface and slot wound armatures, drop forged 100 per cent. pure copper commutators in the process of their manufacture, etc.

Babcock & Wilcox.

Babcock & Wilcox, Limited, of Montreal, had a very interesting exhibit. A feature which attracted much attention was the samples of their special forgings and pressed steel work, for use in connection with their well-known boilers. These forgings are made from plates of the highest grade open hearth steel. They also exhibited samples of their standard boiler fittings, which had only to be seen by practical men to be appreciated. This firm is building and installing a very large number of boilers all over the Dominion and count among their best customers the Canadian Pacific Railway Company, Montreal Street Railway Company, Halifax Electric Railway Company, Intercolonial Railway Company, Canada Car Company, Dominion Steel Car & Foundry Company, Wire & Cable Company, Northern Electric Manufacturing Company, and many others.

NEW TERMINAL STATION AT HAMILTON, ONT.

The large terminal building shown herewith was recently erected for the Hamilton Terminal Company on King street east, that city, and furnishes terminal facilities for six electric railways. It is one of the handsomest structures of the city and is thoroughly fireproof, being constructed of solid masonry and terra cotta on a steel frame. The outside of the building is of Indiana blue limestone for the first storey and of pressed brick with trimmings of Perth Amboy terra cotta above. The cornices and balustrades are all of terra cotta, richly ornamented. On the roof of the building is located a large clock with a dial six feet in diameter, surmounted by a flag pole. The interior columns and beams are reinforced concrete covered with hardwood for office rooms and Terrazzo for corridors and other public places. The main entrance presents a very handsome appearance. It is finished in carved stone and at either side stand two bronze electroliers on stone pedestals. The entrance vestibule is 22 feet square. In the centre of the floor is a large monogram, D. P. & T. Company, standing for Dominion Power & Transmission Company, which controls the various companies whose offices and terminals are in the station building.

The main floor consists of one large room 68 by 108 feet in area. The floor is laid with ceramic tile. The ceiling is 20 feet high. The walls are wainscoted to a height of 10 feet with English veined Italian marble. In the front part of the building is the ticket office, which is entered through the vestibule door. Immediately behind it is a large fire and burglar proof vault 16 feet square, which extends from the basement to the second floor. To the right of the main entrance is located an electric passenger elevator leading to the upper floors. The main floor is lighted throughout by Nernst glower lamps, placed in the ceiling and around the columns. Five double doors from the main room lead to iron fenced inclosures leading to the tracks outside. The station room is very handsomely finished; the woodwork is of quarter-sawed oak, highly polished, and the metal work is of brush brass finish on bronze metal. In the basement are located the toilets.

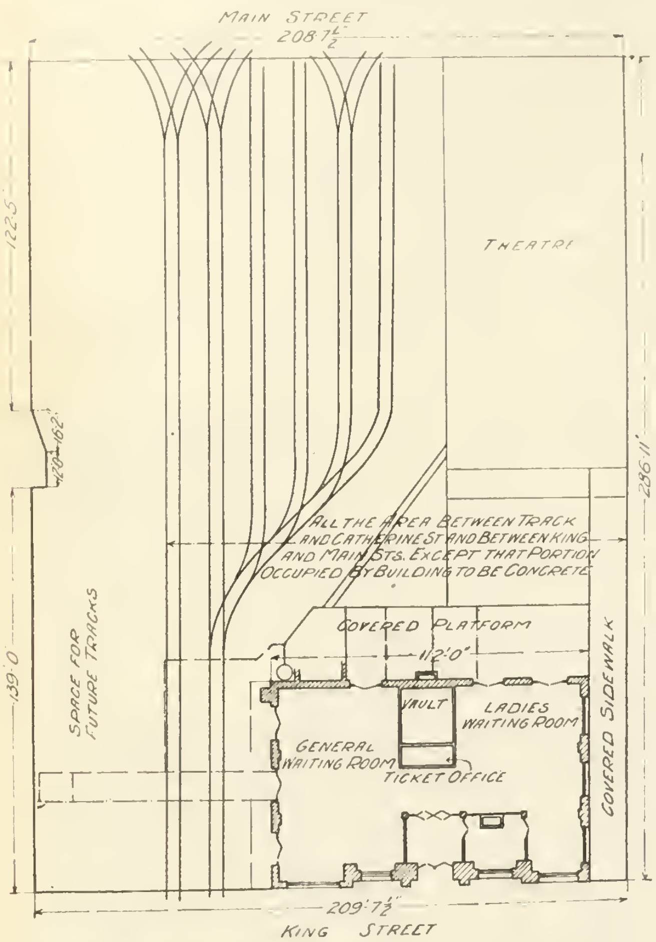
The upper floors are devoted to the general offices of the company and its subsidiary companies. The offices are large and airy and are finished in quarter-sawed oak except the directors' room on the corner, which is finished in mahogany.

New Terminal Station at Hamilton, Ont.

The entire wiring for the building is laid in conduit and is on the three wire system with eight ampere outlets (1,000 circular mills for each ampere). The main distributing panel, located on the station floor, and the subpanels on the upper floors are all controlled by main cut-out switches in the motor generator room in the basement. The entire wiring of the building is made especially heavy in order to provide for any future electrical development. The front of the station building is supplied with outlets for illuminating purposes, so that when desired the entire front of the building may be covered with lights. The covered passageways at the

right and the verandah in the rear are built of steel and copper and are brilliantly lighted by nearly 1,000 incandescent lamps.

A battery of three boilers, which is located under the tracks outside, heats the terminal building and also the



Hamilton Terminal Station—Plan and Track Layout.

Bennett theatre, which is seen in the photograph in the rear and to the right of the station. The building was erected by contract on the cost plus a fixed sum basis, and its construction has been carefully supervised throughout by Charles Mills, of Hamilton, architect.

HYMENEAL.

A wedding of interest to the electrical fraternity took place at the Church of the Ascension, Toronto, on Friday, November 28th, when Mr. J. Stanley Richmond, electrical engineer, of Toronto, took as his life partner Miss Annita Fell. The groomsman was Mr. R. J. Dunlop, of the Canadian Westinghouse Company. Mr. Richmond is the son of Mr. John R. Richmond, of Southport, England, while the bride is the daughter of the late John Fell, also of Southport, a noted railway builder and inventor of the "Fell Centre Railway System," adopted about forty years ago to the crossing of the Mont Cenis pass of the Alps, between St. Michael in France and Susa in Italy. Mr. and Mrs. Richmond are residing at 254 Jarvis street. THE ELECTRICAL NEWS extends congratulations.

BARE WIRE TRANSMISSION TO PRIVATE HOUSES.

A very interesting discussion is at present taking gan of the National Electrical Inspectors' place in "Electrocraft," which is the or-Association, upon the advisability of adapting all-porcelain in place of the usual brass-protected porcelain sockets for lamp-holders. The problem is to a large extent peculiar to America, for two reasons, the first being that the Edison screw-socket lamp is the one almost entirely adapted, and the second that American practice permits of high-pressure overhead lines entering a building, current being often supplied on the alternating system, and converted to low-pressure supply on the premises by means of a transformer. The conditions thus established are the possibility of a swinging contact being made between high and low-pressure wires, such contact being so slight that fuses have not time to melt, but quite sufficient for anyone who is at the time in touch with an unearthed pole of the secondary supply to receive a violent and very possibly a fatal shock. The extreme likelihood of such an occurrence is rendered apparent when it is remembered that it is by no means the universal practice for American electricity supply companies to earth one pole of their secondary circuits. Indeed, we find in the correspondence considered such a landatory paragraph as the following:—"I might state that the lighting company of Montreal is doing a great thing for the Montreal citizens; that is, the grounding of all transformer secondaries. Doing this, you no doubt know, to a great extent prevents many accidents or loss of life, should the primary wires get crossed with secondary by some cause or other, throwing the high voltage on the house wires or fittings."

The screw-socket system is peculiarly adapted for the bestowal of shocks upon unwary persons handling lamps or lamp-holders, and this should be remembered by everyone handling electric signs or other apparatus involving lamp devices imported from America. The outer screwed surface of the Edison lamp constitutes part of the conducting circuit. In some makes of this lamp, the brass butt projects byond the socket from 1 to 2 1-2 threads of the screw, and this is quite enough contact surface to give the fingers of any person handling the lamp a bad shock. One writer, representing the Rocky Mountain Fire Underwriters' Association, states that "personal inquiry and observation have given the writer knowledge of two cases of death from persons coming into circuits of more or less voltage while handling key sockets, and 14 violent injuries from the same cause have appeared in this district within the month. This is know as an exceptionally dry district." His conclusions are that, if the lamp base is properly designed and the line earthed, the cord properly knotted or otherwise protected from steam, and the cord tips soldered in the socket, danger to human life is practically removed.

The city of Brandon, Man., has put in an electric light system of its own and the authorities think that the plant can be enlarged sufficiently for the whole of the municipal ligthing.

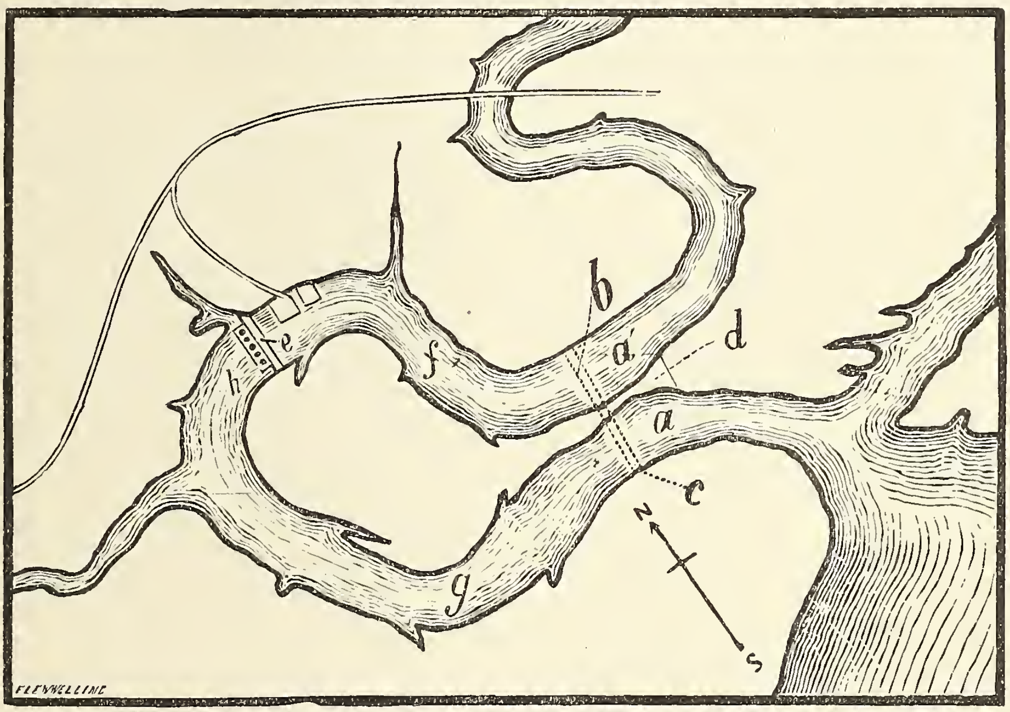
THE COVE ELECTRIC COMPANY'S SYSTEM.

The accompanying drawing shows part of the Tantramar river at Sackville, N.B. Five tide water rivers in Nova Scotia and New Brunswick have bends similar to the one shown in the cut. It is desirable to use our system at points where the rise and fall of the tide is extraordinary, the system herein described being based upon a rise and fall of from thirty to forty-five feet.

In the drawings, we have shown at *a* the lower channel of a tide water stream, and at a^1 the upper channel of said stream above a bend therein. The portion of said stream in said bend we cut off from the rest of the bed of the stream by the dam *b* and the dam *c*, said dams respectfully arranged below a reservoir to be formed above it for the accumulation of water, and below or beyond a discharge basin. Each said dam *b* and *c* has suitable gates therein, whereby the bed of the stream on opposite sides of each dam may be placed in communication with each other. We connect the two channels by an artificial cross channel *d* of substantially the same depth as the river. The bed of the stream beyond the dams *b* and *c*, we divide into two sections by a dam *e*, the section beyond dams *b* and *e* constitutes a reservoir, as *f*, and the section betweens dams *c* and *e* constitutes a discharge basin, which is preferably about twice the area of the reservoir *f*. Arranged below the dam *e*, with as great a height of fall as possible, are the turbines and sluice, or tubes, which pass through the dam *c* at a point to allow water to flow from the reservoir *f* thereto for at least twelve consecutive hours.

The operation of the invention is as follows: It being assumed that both the reservoir *f* and the discharge basin *g* are almost emptied, and the tide is at its lowest ebb. The gates in the dam *b* are opened to permit the tide water to fill the reservoir *f* as the tide rises, and those in the dam *c* are closed to exclude water from the discharge basin *g*. When the tide is at its flood, the gates in the dam *b* are closed. It will be observed that the water also flows to the upper channel a^1 through the artificial channel *d*, thus avoiding any diminution of the quantity of water in said upper channel, and avoiding the violation of any possible rights of the upper riparian owners.

The reservoir *f* being filled, the water flows through the tubes in the dam *e*, to the turbines, and empties into the discharge basin *g*. It is arranged so that the volume of water above said tubes and the number and size of turbines and the consumption of water thereto shall be such as to lower the level of the water in the reservoir, not more than one foot per hour. Such being the case, the discharge basin *g* being twice the area of capacity of the reservoir *f*, will fill at the rate of six inches per hour.



Area of Reservoir, 7.000.000 Sq. Feet. Area of Discharge Basin, 14.000.00 Sq. Feet.
Height of Tide, 48 Feet.

The operation of the turbines is entirely independent of the tides. When the turbines have been running a little over six hours, the tide is again at its lowest ebb, and the river outside the dam is substantially empty. The accumulation of water in the discharge basin *g* is thus discharged into the river by opening the gates in the dam *c*, whereafter said gates are again closed. The water in the reservoir *f*, however, continues to run the turbines for a further six hours or so, until the tide is again near its flood, whereupon the gates in the dam *b* are again opened to replenish the supply of water in the reservoir.

When the tide is again low, the gates in the dam *c* having been closed for twelve hours, there will be an accumulation of six feet of water, more or less, in the discharge basin *g*, which is the greatest height to which the water in said basin will rise.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All enquiries will be answered in the order received, unless special circumstances warrant other action.
2. Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.
3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.
4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.
5. In all cases the names of our correspondents will be treated confidentially.

Question No. 1.—How can the c. p. of an a. c. arc lamp—series or multiple—be determined from the voltage and amperage, or is a photometer necessary for this purpose?

Answer.—The only way by which you can definitely determine the candle power of any illuminant is to actually measure the light given, this being done by means of a photometer, of which you speak. On the other hand, this is such a difficult operation when considering large candle powers such as those given by arc lamps, that it is but very seldom done, the numerous investigations which have been made from time to time by those having the necessary apparatus and time at their disposal being accepted as standards. These measurements show that a 6 ampere multiple alternating arc lamp will give about 180 to 200 average spherical candle power, or say 2 1-4 to 2 1-2 watts per candle power. A series lamp, owing to the fact that it has no reactive coil, is slightly more efficient, in view of which you might expect results from it that were 5 per cent. to 10 per cent. better than the multiple form.

Question No. 2.—What is a balancer coil, and what are they used for?

Answer.—Balancer coils are simply reactances, wound very similarly to the secondaries of transformers, as they consist of simply the one continuous winding on an iron core, with a tap taken out from the middle, or from some other point, depending upon the voltages desired. They are used for two distinct purposes. The first is in connection with three wire direct current generators, where they are connected across the alternating potential obtained from the slip rings, the centre tap from the coil giving the neutral for the three wire direct current service. Their other use is to provide a 110 volt circuit for lighting from a higher potential alternating power circuit, usually either 220 or 440 volts. In either of these two latter cases they are connected directly across the line, either in the dynamo room or else, if the group of lights is some distance away, in the building to be lighted. For 220 volts there would be just one tap in the middle of the winding giving a 110-220 three wire lighting circuit. For 440 volts there would be three taps, giving a 110-440 volt five wire lighting circuit. They can of course be made with four taps for 550 volts, but the added complication, combined with the fact that as far as grounds, shocks, etc., are concerned, the lights are operating on a 550 volt circuit, makes it probably more desirable to put in an ordinary transformer.

Question No. 3.—Not long ago I saw an article on an instrument for recording or transmitting written messages automatically. Can you tell me what it is?

Answer.—You evidently refer to the "Gray Telautograph," an instrument which reproduces any message written into it at one end, not only in the exact words, but in the exact handwriting, of the sender. The action is instantaneous, the pencil at the receiving end moving simultaneously with that at the transmitter. Both are carried in frames or guides, somewhat after the style of a reducing pantagraph. The instrument is very useful in large power houses where the control board is located away from the generator room, also in banks and other financial institutions where a means of communicating privately, noiselessly, and without delay, besides having a permanent record, is most valuable. able.

Question No. 4.—Would you please give me the rule for finding the different core and copper losses in a transformer with a change in voltage?

Answer.—The core losses always go up with an increase of voltage, due to the fact that as the voltage is raised the flux must necessarily increase with it. This in turn means greater losses, since the higher the magnetic density in any piece of iron, the greater energy does it take to magnetize and de-magnetize it, and greater energy means simply that much more power lost. On the other hand, the copper losses decrease with increased voltages, because, for a given input or output, the higher the voltage the less the current. Naturally, the smaller the current the less the drop in the transformer windings, which means simply lower losses.

The copper losses will vary inversely as the square of the voltages, but one cannot give any exact rule for the changes in the core losses, because they vary in different transformers, due to various points in the design, more particularly the original density. Roughly speaking, you can figure that the core loss will vary twice as fast as the voltage, in other words, a 5 per cent. increase in voltage will mean 10 per cent. greater core loss. The same rule will also be aproximately correct for the copper losses, remembering that they vary the other way, that is, a 5 per cent. increase in voltage will mean a 10 per cent. decrease in copper losses.

George H. Cove, a Nova Scotian, who has been experimenting in New York and Boston on the transmission of electrical power without wires, has lately moved to Halifax, N.S., where he will continue his experiments.

Mr. Cove has been very successful in transmitting power for over half a mile and is at present constructing a transmitting and receiving station for transmitting two miles. He expects to be transmitting wireless for power 25 miles before another year, with less than ten per cent. loss in transmission.

BOOK REVIEW.

A neat little pocket manual, full of varied and useful information for electrical engineers, has recently been published by the Norman W. Henley Publishing Company, New York. The author is Mr. Sydney F. Walker, R.N. No claim to originality is made by the author in respect of the matter presented, but in selection and arrangement particular care has been taken to include only that which would be of use to the practising engineer. With that end in view a considerable fund of information as to sizes, weight efficiencies, dimensions, etc., of electrical apparatus and appliances has been incorporated, together with over 300 diagrams and illustrations. As a handy reference volume Mr. Walker's work should be of great value to the working engineer. The book is neatly bound in Morocco, and sells at $3 net.

"The Electric Telegraph" is the title of a well-written manual by Charles Thom, Chief of Quadruplex Department, Western Union Telegraph Company, and A. F. Collins, author of "Wireless Telegraphy, its History, Theory and Practice," dealing with the principles and practice of wireless telegraphy. The work is neatly bound and well printed, is illustrated by some excellent cuts, and is divided into two parts, dealing respectively with the electric telegraph and the subject proper, the system being explained throughout in a most practical manner. Publishers, The American School of Correspondence. Price, $1.

POWER FROM A QUARTER MILE HEAD.

The highest fall of water ever used for power seems to be that of Lake Brusio, in Switzerland, where is located the most powerful electricity generating station in Europe. The water of the Poshiavino, in the Poshchiavo Valley, is led through a great conduit, three miles long, to the reservoir, from which five sets of enormous pipes conduct it to the power station at a level 1,280 feet lower. Electric energy of 36,000 horse-power is distributed from the generators to points along the shores of Lakes Como and Maggiore, and as far as the great plain of Milan.

NEW FIRM OF MECHANICAL ENGINEERS.

A new firm of mechanical engineers, Messrs. Hawker & Palmer, have recently opened offices at 84 Victoria street, Toronto, and will make a specialty of inspecting and remodeling steam plants and of supervising tests. Mr. Albert E. Hawker, who is the representative of the Cleveland Engineering Company, of Cleveland, Ohio, was for six months consulting engineer on the Joseph Simpson & Sons' plant at Toronto. Mr. A. I. Palmer, formerly of Pittsburg, was chief inspector for the Casualty Company of America on boiler insurance and general inspection.

The use of the guillotine or of electricity in killing animals for food in place of the methods now in use was advocated in a paper read by Henry Bergh, of New York, before the American Humane Association in Boston on November 13th.

TORONTO WILL VOTE ON POWER BY-LAW.

A power by-law will be submitted to the rate payers of Toronto in January next to provide for the raising of $2,500,000 for the establishment of a civic power and light distributing plant. Messrs. Smith, Kerry & Chace, engineers, Toronto, who had been retained by the city to prepare a report on the possible systems to be adopted and their comparative costs, submitted three alternatives, as follows:—No. 1, complete system, underground mains in the section bounded by Bathurst, Sherbourne street, Bay, C.P.R. tracks and Rosedale, $5,250,973; No. 2, underground mains in the section bounded by Bathurst, Sherbourne, Bay and College and Carlton, $4,252,598; No. 3, the underground area of No. 1, with the capacity of the underground system reduced, $1,775,554.

At a special meeting of independent engineers, representatives of the Hydro-Electric Power Commission and of members of the Toronto Board of Control, held for the purpose of discussing these several alternatives, it was agreed that an expenditure of $2,500,000 would be sufficient to give the city the necessary equipment and service to supply it for some years to come, working in conjunction with the Toronto Electric Light Company.

This decision was based upon a special report, prepared by Mr. Alexander Dow, electrical expert Detroit, which was as follows:—

"After consideration and after discussing a number of details with Messrs. Smith, Kerry & Chase, I have to report to you that I concur in, and approve of, their conclusions as to total cost. I am of the opinion that these totals are reasonable and sufficient. In respect of certain details and as to certain suggested methods I do not concur; but, inasmuch as these differences do not affect the main provisions of the estimates, they are at present immaterial.

"These estimates have been made in accordance with the instructions given, but in discussions of the general question it has appeared to me that we should submit to you a further estimate, not strictly in accordance with the instructions given; to wit, an estimate, based on the reasonable expectations of the public demand for service within the next four or five years, remembering that the present electrical service will not be displaced, but will continue in competition with the service given by the city, and that the city need not provide for such part of the distribution as the existing system shall continue to supply.

"There is obviously going to be a sharing of the work at least for some years to come. This being granted, it is clear to me that the city can provide for the share of the existing business likely to be secured by it, and all the growth resonably to be expected, with investment much smaller than either estimate one or two. And further, it is clear to me that the area to be served by underground mains should not be limited as in either estimate by said boundaries, but should be fixed after study of each street and block in such manner that the

central congested area of the city would be included, and all main travelled streets leading outward therefrom, the rule being to place wires underground first in those streets where this expensive construction would tend to the safety and facility of travel of the greatest number of people. It appears to me that a much-travelled highway two miles from the centre of the city should in this respect be preferred before a highway under the shadow of the City Hall.

"Still further, it is clear to me that it is not the best public policy to restrict the operation of municipal electric distribution to any one area of the municipality. Estimate three provides for the area in which is required the largest amount of power per front foot. That this is likewise the central area of the city, and includes the principal thoroughfares, is a sequence of the social development of the city. But this estimate leaves unsupplied the important demand for power from factories located along railroad tracks and in the outer manufacturing area, and its acceptance will tend to congest the one area served, contrary to the general good.

"Giving these considerations their proper value, I estimate that for not to exceed $2,500,000 the city can construct a distribution system which can provide for the following:—

"Fifteen hundred street lights, power delivered to pumping stations, lighting of public buildings, underground conductors in central area, say three-quarters of a mile square, and main streets leading therefrom; supply of power to factories along railroad lines, and all principal factory areas; supply of light and incidental power in suitable manner in all parts of the city where there is a reasonable demand; facilities for extension, namely; square ducts in conduits, spare arms on pole lines, and spare floor space in sub-stations. The estimate being based on the receipt of say 12,000 horse-power, and these spares being sufficient for an increase to say 20,000 horse-power.

"In making the foregoing estimate I am assuming that three phase twenty-five cycle current, being the form in which Niagara power can be used with the least investment in distributing system, will be delivered for all purposes for which that current is satisfactorily used. I am assuming also that the efficient magnetite street light will be used, as recommended by Messrs. Smith, Kerry & Chace, and that all equipment will be such as to give a service capable of successful competition with the electrical and steam services now used in Toronto."

Toronto Electric Light Company Makes Offer.

In order to make clear the attitude of the Toronto Electric Light Company in reference to the establishment of a rival plant, the following letter was recently sent to Mayor Coatsworth by Sir Henry M. Pellatt, president of the company:—

"An impression seems to have gone abroad that our company is unwilling to meet the City Council in reference to the making of some arrangement which might obviate the necessity for a very large expenditure of public money in a duplicate power and distributing plant for the city of Toronto.

"As to this I would say that the company is ready and willing at any time to meet yourself or the Board of Control with a view of arriving at some understanding which will fairly meet the situation and be in the best interests of all concerned."

In connection with this statement the Toronto Electric Light Company have offered either to sell to the city outright or to conduct their present plant on a co-operative basis, selling the municipality a certain amount of stock. This offer, Sir Henry Pellatt declares, will hold good regardless of the fate of the power by-law: "If the by-law does not carry, and the city wishes to renew the negotiations on the basis already proposed, I may say frankly that the company will do so. I would say that we have always been ready to meet the reasonable demand of the city; also that it is our purpose to make a reduction in price to consumers (whether the proposed by-law carries or not) as soon as we are able to determine what the reduction can be."

In view of the fact that the acceptance by the city of either one of these alternatives would render unnecessary the expensive and unnecessary duplication of the Toronto Electric Light Company's plant, it is probable that the carrying of the by-law will not be an easy matter, particularly at this season of financial depression.

THE RESPONSIBILITY OF ELECTRICAL COMPANIES FOR ACCIDENTS.

(Continued from page 18.)

above the roadway (Freeman vs. Brooklyn Heights R. Co., ante, p. 611), on the top of a wooden awning sixteen feet above the street (Brush Elec. L. & P. Co. vs. Lefevre, ante, p. 598); upon structures so high that no person could reasonably be expected to be injured by them, however extraordinary his duties (Calumet Elec. St. Ry. Co. vs. Grosse, note 1, ante); upon a jet in front of a house (Keefe vs. Narragansett Elec. Lt. Co., note 1, ante)."

It was held in the Dunphy case, above referred to, that the failure to attempt insulation where the weight of evidence was that insulation would be impracticable, would not, in itself, constitute negligence.

As regards maintenance and inspection, although a certain divergence of opinion is found in the jurisprudence, the weight of authority is that a company is not bound to constantly patrol its lines, but, on the other hand, the failure to exercise reasonable diligence in repairing breaks and other sources of danger would, of course, be negligence and would render it liable.

In case of the Guardian Assurance Company vs. the Quebec Light & Power Company, one of the judges in the lower courts expressed the opinion that it was the duty of a company to regularly test its transformers from time to time, but as this decision was reversed by the Supreme Court on other grounds, the obiter dictum of the learned judge cannot be said to have the weight of authority.

Regarding the duty of an electric company towards its employes, the law of Quebec differs very considerably from that of the other Provinces, being much more severe upon the employer. In the first place contributory negligence on the part of the employe in the Province of Quebec would not in itself defeat the action, but would only go to reduce the damages. The jurisprudence in the Province of Quebec is, moreover, that employers are bound to protect their employes, not only against their own imprudence, but even against their own disobedience, and that it is not sufficient to issue instructions, but employers are bound to see that these instructions are obeyed. Inasmuch as no Workmen's Compensation Act is in force in the Province of Quebec, the consequences are somewhat severe upon employers.

As to the other provinces of Canada the rule laid down by Joyce would probably apply:—

''Electrical companies do not insure the safety of the employes, but the latter are subject to the general rule that one who chooses to enter into an employment, involving danger of personal injury, which the master himself might have avoided, assumes all risks incident to the employment, and which are known to him or are either plain and obvious, and which he has no reason to expect will be counteracted or removed, and that the employe cannot recover for injuries resulting from such dangers. So the company is not compelled to furnish employes with printed rules for their government, guidance and safety, when the nature of an employment makes it dangerous, and the danger incident thereto and growing out of it are of common knowledge and are fully known to and understood by the servant, and the safety of others cannot be imperiled by any act or omission of his in the performance of his duties, and his safety depends wholly upon the degree of care, skill and caution used by himself. And if an employe voluntarily chooses the most hazardous of two or more methods of performing his work, it is held that he does so at his own risk. But, even though a person is employed in the presence of known danger, it is held that to constitute contributory negligence it must be shown that the employe voluntarily and unnecessarily exposed himself thereto, unless it is of that character that he must assume the risk from the very nature of the danger to which he is exposed.''

''I cannot concur with him in thinking that they can be held responsible for the effects of the electric current 'under any circumstances.' This would be placing their liability too high and be constituting them insurers. They are bound to carry on their business with all possible skill, care and foresight, and are bound, in doing so, to anticipate and take into consideration such conditions of weather as may be reasonably expected in our climate. The law in requiring from them the highest care and skill and the exercise of constant vigilance in their business and operations does nothing more than, having regard to the extremely dangerous character of the article or substance they supply, is necessarily for the proper protection of those with whom they deal. But, on the other hand, before they can be held liable, there must be shown to have been the absence of some one of these necessary precautions, or of the required skill and vigilance; in other words, some negligence to which the accident can be reasonably attributed must be found.''

These latter remarks would equally apply to the duty of companies as towards the general public.

As to the duty of electrical companies toward the public the matter cannt be summed up better than is done by Joyce, paragraph 438:—

''As a general rule electrical companies, aside from their obligations to employes and other companies, while not insurers of the absolute safety of the public against all dangers arising from the lawful erection and maintenance of their lines in the streets, are bound to exercise such reasonable care in the maintenance of such lines as a prudent, careful, person would take of property of a similar character, in constant use and continually exposed to the effect of the atmosphere and of the weather.''

The last question which I propose to touch upon briefly is as to the burden of proof, a question which is very fully discussed in the recent case of the Guardian Assurance Company vs. the Quebec Light & Power Company, 37 S.C.R. 636, where the actual cause of the fire, although admitted to be electrical, was not susceptible of actual determination. It was held by the Court of Review in Quebec, reversing the decision of the trial judge, that upon its being shown that the fire was electrical, that the burden of proof fell upon the company to show that it was not caused through its fault. Fortunately for electrical companies generally this decision was reversed by the Supreme Court, where it was held that the ordinary rules of evidence apply and that it was for the plaintiff to prove his case, and, that in the absence of absolute proof or overwhelming presumption, the action must be dismissed.

While this paper is by no means complete, lack of time must prevent any further elaboration, but it is hoped that it may be found of service, as well as of interest, to the members of this Association.

A COSTLY ELECTRIC LINE.

Details of a marvelous electric railroad now projected from Milan to Genoa, Italy, are given by L. B. Ward in the October ''World To-day.'' Although only 85 miles long, the road will encounter such a mass of tunnels and bridges that the cost will average over $500,000 a mile. To avoid all grade crossings, 372 bridges and 19 tunnels are to be constructed, one tunnel being 12 miles long. It will take six years to complete the line. Electric locomotives of 1,000 horse-power will be used, with a 72,000 horse-power current generated by water-power, giving a speed of 80 miles an hour. The road is to carry freight as well as passengers, and will link the two cities into one community.

SPARKS.

An electric lighting plant has just been installed at Wolseley, Sask.

The Berlin Electrical Manufacturing Company are reported to have assigned.

Okotoks, Alta., is considering the acquisition of the local company's electric light plant.

The capital of the Brandon Electric Light Company has been increased from $125,000 to $400,000.

The Cobalt Contact Company will install a gas producer power plant with six drill compressor early next season.

The total upon which the Brantford ratepayers will be asked to vote in connection with Niagara power is $67,011.

John Davis, civil engineer, of Alton, Ont., has succumbed to injuries received at Kelly's crossing on the C. P. R.

The Central Electric Light Company, Portgage la Prairie, Man., are preparing to extend their power plant at a cost of $35,000.

A by-law is to be submitted to the ratepayers of Hamilton, Ont., to raise $225,000 for a civic lighting and power plant.

Tenders have closed for the construction of Calgary's street railway system which it is hoped wil be comleted within a year.

The city council of Winnipeg carried an appropriation last month for the expenditure of another $22,000 on the power plant.

A by-law has been passed at Kelowna, B. C., authorizing the expenditure of $40,000 on extensions to the electric light plant and water works.

At the January elections the ratepayers of London, Ont., will vote on a by-law to raise $235,000 for the transmission of Niagara power to the city.

The Nanaimo, B.C., Electric Light, Power & Heat Company, will increase the capacity of their plant by building a large dam at Westwood's Swamp.

In an accident which recently occurred at the St. Pierre, N.B., lighting plant, damage was done to the power house and machinery to the extent of $2,500.

Engineer Aiken, of Toronto, has valued the electric lighting plant at Listowel, Ont., at $1,276. The citizens are considering the installation of a new plant.

The revenue from the municipal light and power plant at Brockville, Ont., for the past year was as follows: gas, $27,954; electricity, $18,298. The gross profits were $17,666.

The city council of St. Thomas, Ont., have received the estimate of Engineer Richards, of the Hydro-Electric Power Commission, for a distributing plant. The amount called for is $42,493.

Ross & Holgate, electrical engineers, Montreal, have been asked to furnish a valuation of the Ingersoll Electric Power & Light Company's plant. Early in the year the company asked the council a sum of $5,000.

In connection with the new power plant at Edmonton, Alta., it is interesting to note that an Allis-Chambers producer gas engine, unit of 600 k. w., is to be installed next June. The plant will be the largest of its kind in the Dominion.

In connection with the Winnipeg power scheme the Board of Control have instructed the consulting engineers to examine the specifications with a view to ascertaining the necessity of altering same preparatory to taking fresh tenders.

A proposal has been submitted to the International Waterways Commission by the St. Lawrence Power Company for the damming of the Longue Sault Rapids. The project would cost $5,000,000 but the rapids would disappear.

The financial stringency of the past few months has forced the Stark Telephone Light & Power System, Limited, Toronto, Ont., into liquidation. It is hoped that the concern will be reorganized. The company was formed in 1903 with a capital of $1,000,000.

Director Gifford, of the B. C. Eeletric Railway Company, Victoria, announced a short while ago that his company had formed a plan for the installation in the near future of a new water power plant. In this connection the company have since staked rights on the Jordan River, where they will ultimately develop 20,000 horse-power.

For some time the civic employes engaged in constructing a bridge over the Pinawa Channel at Lac du Bonnet, Winnipeg, have been at loggerheads with the employes of the Electric Railway Company and a short time ago their differences culminated in a regular pitched battle. A truce was finally arranged and the matter referred to arbitration. The cause of the trouble is attributed to the Electric Railway Company or the General Power Company as they are called, who, it is alleged, have been using every effort to delay the progress of the city in the development of the Point du Bois power.

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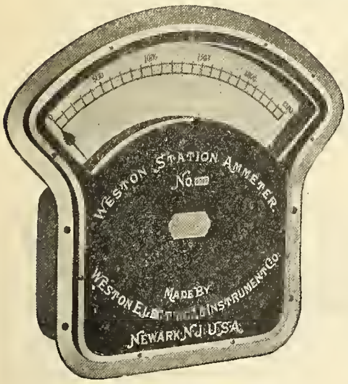

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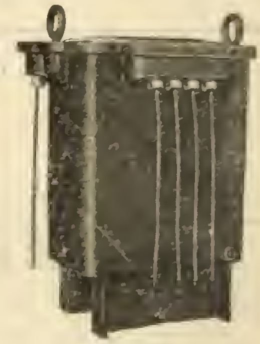

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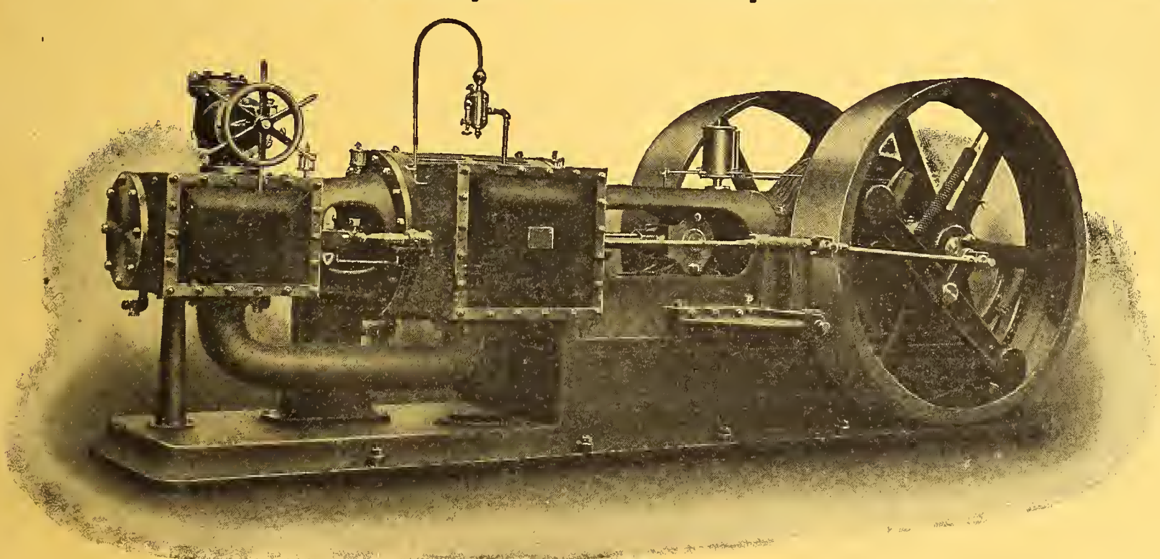

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